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Forest Service
Southern Region

Managing the Family Forest in the South

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ROCKY MT. FOREST & RANGE
EXPERIMENT STATION

Management Bulletin R8-MB 1

Revised September 1992

METRIC CONVERSIONS

1 inch	2.54 centimeters
1 foot	30.48 centimeters
1 pound	453.59 grams
1 acre	0.4047 hectare
1 board foot (12 x 12 x 1 inch thick, without bark, ¼-inch International Scale)	0.00348 cubic meter

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Managing the Family Forest in the South

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INTRODUCTION

Many of our forefathers came to this country because it offered an opportunity to own land. This desire is still inherent in many farmers and other private individuals who own 67 percent of the 182,164,000 acres of commercial forest land in the South. The practice of forestry on these holdings offers individuals something that can be both financially and spiritually rewarding and, at the same time, contribute to the local and national economies.

Many small woodlands are on highly productive sites and are close to good markets. However, the net annual growth on these forested acres often fall far short of their potential growth rate. This suggests that most landowners are not fully managing their forest resources.

To some, forest management means only management for timber production. However, in its broadest sense, forest management means management of forested acres for the continuous production of goods and services such as wood, water, wildlife, forage, and recreation. Owners should assess their own objectives so that their management plans will meet these objectives. The following pages describe how to increase timber yields, improve wildlife habitat, protect watersheds, obtain greater enjoyment from owning land and, in certain circumstances, use the forest forage. Sound forest management involves these steps:

- Locate and mark property boundaries and corners. Get technical advice, if needed
- Develop a forest management plan with the help of a professional forester
- Use your State's Best Management Practices[1] in all your activities

[1]Contact your State forestry agency for a copy.

- Draw up, and follow, a schedule of forest practices
- Provide for fire protection
- Sell only marked or designated timber
- Get technical assistance when making timber sales
- Use a timber sales contract when selling timber or other forest products
- Set aside part of your timber sale revenues to reinvest in reforestation and other activities to keep your property productive.
- Take advantage of cost sharing assistance
- Supervise cultural operations
- Check the forest periodically for insect and disease problems
- Acquaint your whole family with the forest
- Keep good records on costs and returns
- Enjoy your ownership and the practice of good forest resource management.

If you follow these steps faithfully a whole new world will open up to you and your family. The following pages describe sound forest management practices in detail.

FIRST YOU NEED A MANAGEMENT PLAN

What would you think of someone starting an automobile trip in an unfamiliar area without a roadmap or with an unidentified destination? Adventurous? Unwise? Forestland owners who operate without a management plan are very much like such a person. A well-prepared forest management plan serves as a **roadmap** (a

series of scheduled activities) showing how to reach some predetermined **destination** (your management objectives). A management plan can save you money, increase your profits, and decrease your taxes. Management plans don't need to be lengthy or complex. They may be as simple as a page or two with a map, as shown by the example in figure 1.

MANAGEMENT OBJECTIVES

What you want from your property is considered **your management objectives**. They are important and uniquely yours. Do you desire your forest to produce optimum levels of wildlife populations? What levels of scenic qualities do you wish to maintain? Are you interested in receiving sustained periodic income from the property? From what sources? Leases? Timber sales? Perhaps you prefer a combination of two or more objectives to diversify the benefits you receive. Once you select your management objective(s), it becomes your destination or target toward which future management activities are planned.

Management objectives should be compatible with the potential of the sites and property you own. For example, managing for optimum bobwhite quail habitat in hardwood forest isn't recommended. Neither would management for gray squirrel on properties with few hardwoods.

If you are interested in maximizing and sustaining forest income from future timber sales, follow these basic principles:

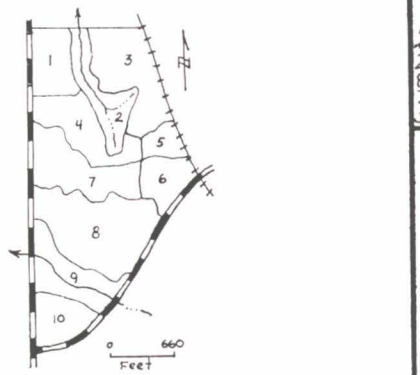
1. Build up the total volume of your timber growing stock to the property's potential by cutting only a part of the annual or periodic growth. Allow the uncut growth to accumulate as "principal in the bank." Once the total timber volume on the property has reached its optimum level, then harvest cuts should begin to equal annual or periodic growth.

2. Consider the growth potential of each stand. Sometimes an understocked stand can be rehabilitated by "growing itself" into

A Forest Management Plan

Prepared For: Your name

Stand #	Acres	Forest Type Current	Forest Type Preferred	Treatment Year	Treatment Year	Treatment Year	Treatment Year	Treatment Year	Remarks
1	5	O	LP	PL/1992	PB/2009	TH/2010	TH/2020	—	
2	8	OP	OP	TH/1993	RH/1995	TH/2010	—	-	Favor cherrybark and water oaks
3	11	LP	LP	TH/1993	TH/2010	PB/2025	CC/2026	RH& PL/2027	
4	10	LP	LP	TH/1993	TH/2000	TH/2010	—	—	
5	3	WL	WL	HFW/annually (Remove 5 cords of fuelwood annually for personal consumption—confine harvest to small clear cut areas)					
6	5	HS	HS	SC/as needed		—	—	-	
7	12	OP	LP	PB/1992	ST/1993	RST/1996	PCT(1998 if needed)	TH/2020	Leave 10 seedtrees per acre
8	19	P	P	MP/annually		—	—	—	
9	8	OP	OP	TH/1993	RH/1995	TH/2010	—	—	Favor cherrybark and water oaks
10	8	LP	LP	TH/1993	PB/2009	ST/2010	RST/2013	PCT/2015	Leave 10 seedtrees per acre



Management Objectives

1. Maximize future income by maintaining healthy well stocked pine stands in areas 1, 3, 4, 7, and 10.
2. Maintain mixed pine-hardwoods in areas 2 and 9. Enhance hardmast production for squirrel, deer and turkey.
3. Maintain area 8 as an improved pasture.

Prepared By: your local Forester

Forest Type Codes

LP = Loblolly pine
OP = Oak/pine
WL = Woodlot
O = Open
P = Pasture
HS = Housesite

Treatment Codes

TH = Thin from below-commercial cut
PL = Plant loblolly pine seedlings
ST = Seedtree cut
RST = Remove seedtrees
SC = Salvage cut trees likely to die
PB = Prescribed burn
PCT = Precommercial thinning
MP = Maintain pasture
RH = Remove unwanted trees
HFW = Harvest fuelwood
MP = Maintain pasture

Figure 1.— Example of custom-made forest management Plan

full stocking more quickly and economically than starting over with new reproduction.

3. If regeneration treatments are necessary, concentrate first on your most poorly stocked stands. Also, getting your most fertile sites productive should take priority over the less fertile sites.

4. Control spacing by initial planting density or thinning so your best trees reach the most valuable product sizes in the shortest period of time.

REGENERATING THE FOREST

The best time to plan on regenerating a stand of trees is before harvest. Unfortunately, many acres of forest land harvested in the South are not regenerated adequately by natural means, by planting, or by seeding. The end result is usually a tract of land with little or no reproduction of desirable species. "Accidental" forestry seldom pays good dividends.

Before harvest, you should decide on the species desired, the methods of regeneration and the timing of treatments to fully reforest the land.

Two regeneration alternatives are open to landowners. The first alternative is to manage for natural regeneration through planned cultural practices. Secondly, you may wish to harvest completely, and follow up with planting or seeding to establish the new forest.

NATURAL REGENERATION

Natural regeneration involves more than simply letting nature take its course. Forests must be carefully managed for effective natural regeneration. If this is not done, the time lag between harvest and the establishment of a new crop of trees could mean economic suicide. Excessive numbers of seedlings could require expensive precommercial thinning, wiping out any savings in planting cost. A

scarcity of new tree seedlings could under-utilize the planting site, robbing the owner of potential returns from the land. Effective natural reforestation is seldom free; it does not "just happen."

MANAGEMENT SYSTEMS FOR NATURALLY REGENERATING PINE

If you decide to use natural regeneration for pines, a variety of uneven-aged and even-aged management systems are open to you.

After removing most of the poor quality trees in your stand, you may still have a good stocking of vigorously growing pine over much of the acreage. Therefore, you may want to manage for an uneven-aged forest. Do this by periodically harvesting groups of trees, creating openings for natural regeneration. The result, in time, is a mosaic of groups or small stands of different aged trees.

If you want to use even-aged management (all trees in a given area are regenerated at the same time), at least five methods are available:

1. **Seed tree** is the most frequently used natural regeneration method in even-aged management. The number of seed trees left depends upon size, species, cone-bearing characteristics, and site conditions. See figure 2. The recommended number of well-distributed seed trees for five species of pines is given in table 1.
2. **Clearcutting in strips** enables you to make periodic harvest cuts while managing even-aged units. The clearcut strips may be of any length, but preferably about 200 feet wide. Strips should be perpendicular to the direction of prevailing winds to ensure good seed dispersal. See figure 3.
3. **Shelterwood** entails leaving many seed trees. Usually, about 25 to 40 square feet of basal area are left per acre, depending upon the species. This is the equivalent of 23 to 37 14-inch trees (diameter at 4.5 feet) per acre. See figure 4.
4. **Seed-in-place** involves clearcutting the stand after the peak of seed fall, but before the start of germination. This method is best applied during a 4- to 5-month winter logging period. As with the seedlings-in-place method (described below) this technique can be used only when an ample crop of seed is available. See figure 5.

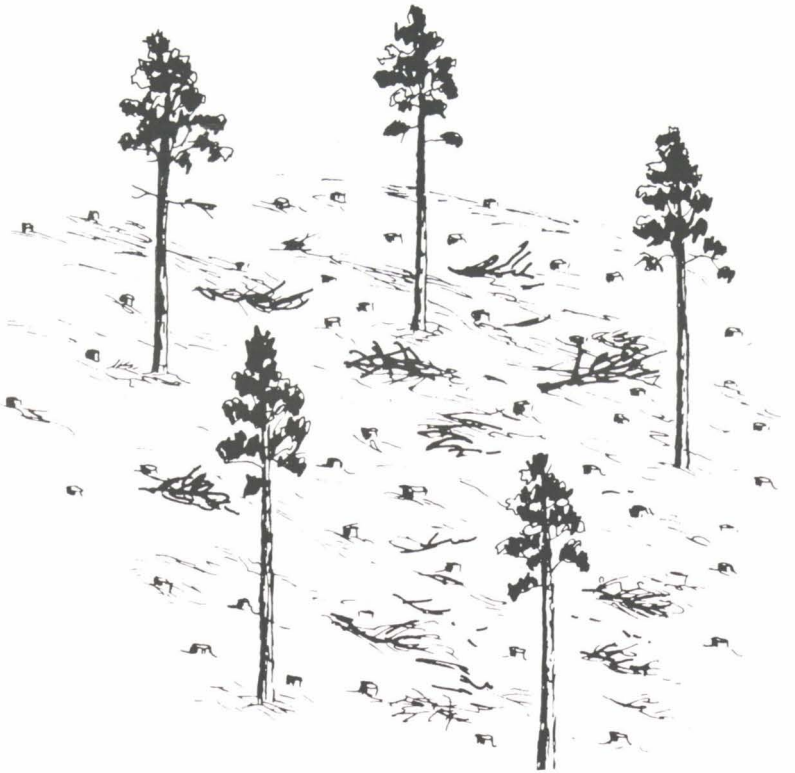


Figure 2. – Seed trees.

Table 1. – Minimum recommended number of seed trees, for pine species.

D.B.H.[1]	Shortleaf	Loblolly	Slash	Longleaf[2]	Virginia
9					6
10	20	12	12	55	5
12	14	9	9	38	4
14	12	6	6	28	4
16+	12	4	4	21	4

[1]Diameter of trunk in inches at breast height (4½ feet above ground).

[2]Shelterwood — 30 square feet basal area.

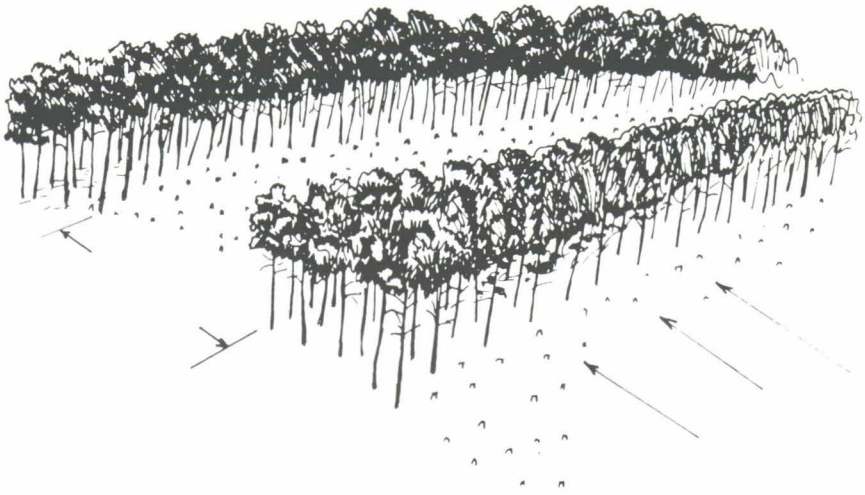


Figure 3. – Clearcutting in strips.

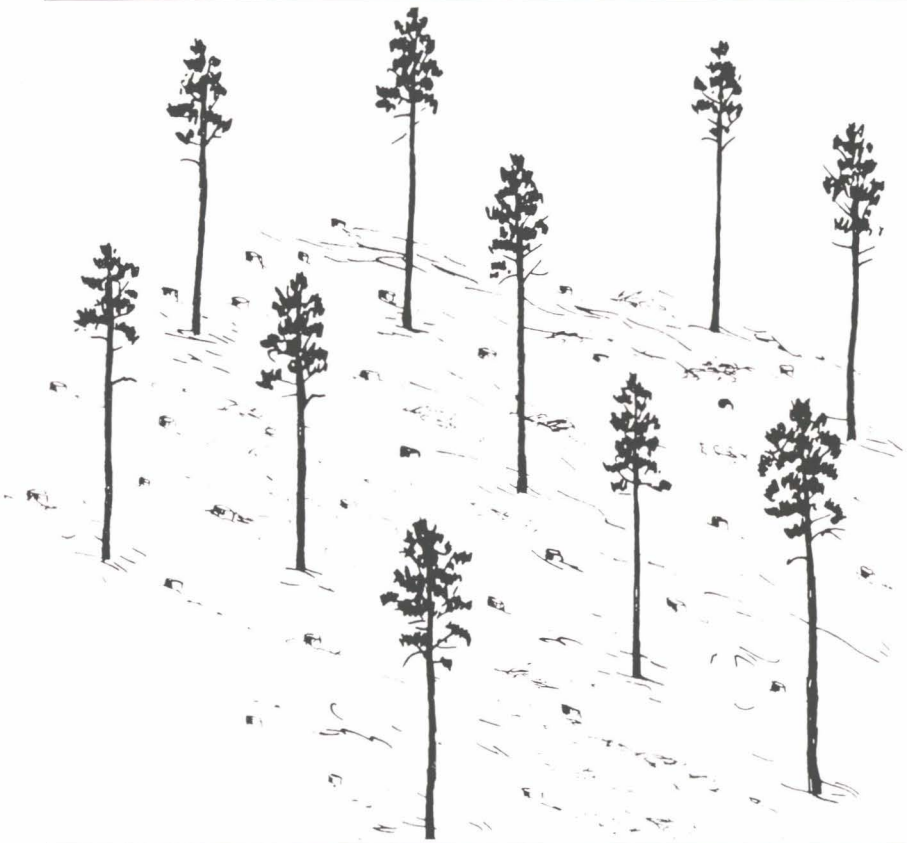


Figure 4. – Shelterwood.

5. **Seedlings-in-place** involves clearcutting a stand during the summer following a good seed year. See figure 6. Using this method, you will lose some height growth when compared to the seed-in-place method because seedlings spend most of the first growing season in the shade of the overwood. However, the loss in height growth may be offset by additional volume growth of harvested trees. With the seedlings-in-place technique, you can be more certain of having a satisfactory actual number of seedlings following germination of the fallen seed.

Figure 5. – Seed-in-place.

Figure 6. – Seedling in place.

SEEDING CHARACTERISTICS OF SOUTHERN PINES

Seeding characteristics of the southern pine species vary with the area, species, weather conditions, and other factors. The landowner, with the guidance of a professional forester, must estimate the best time to catch and utilize a seedfall. Here are a few points to consider:

1. Loblolly, Virginia and shortleaf pines are the most dependable seed producers. Trees that have an adequate growing space usually will produce an adequate seed crop at least every 2 or 3 years. Cones of the major species of southern pines are shown in figure 7. The number of seed trees needed for a good crop of seed from pines is shown in table 1.
2. Longleaf pine is not a prolific seed producer. Its large seeds appeal to a host of predators, including squirrels, birds, and mice. A carefully selected stand, 30 or more years of age, with a density of about 30 square feet of basal area per acre, produces usable crops at about 3-year intervals on average sites.
3. Slash pine seeds are generally produced on 3-year cycles, although some are borne almost every year.

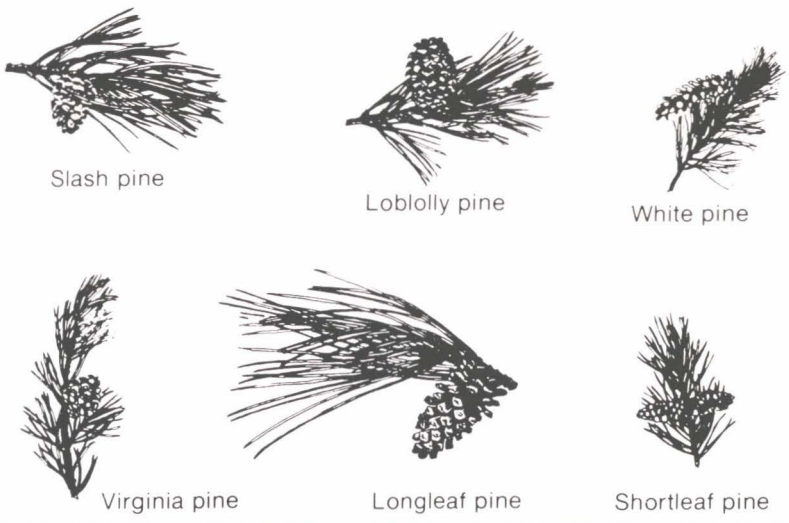


Figure 7. – Cones of each of six species of pine.

4. About 50,000 seeds per acre is the minimum needed to restock a prepared seedbed.
5. When selecting seed trees, remember that pine pollen is not carried in effective quantities farther than 300 feet.
6. The range of longleaf seed flight is only one and one-half times the tree height. Effective dispersal by wind of loblolly and shortleaf pine seed is about 200 feet.
7. Releasing seed trees from competition usually stimulates a substantial increase in seed production by the third year following release.

SITE PREPARATION

Site preparation is generally desirable for natural regeneration. Longleaf and slash pines in particular require a seedbed of exposed mineral soil to achieve a satisfactory restocking of seedlings. The types or combinations of site preparation needed depend upon the expected seed crop and the species of pine. An important point to remember is that most natural pine regeneration in the South has resulted in *too much* stocking, not too little.

Logging

In some cases, soil disturbance occurring during the logging operation is sufficient to provide a good seedbed.

Herbicides

If hardwood competition is moderate, aerial or ground application of herbicides can be done within 1 to 3 years after logging. Assuming only one treatment for release from hardwood competition is needed, the cost should run about $15 to $25 per acre. Herbicides reduce sprout development, allowing pine regeneration to become established within 2 to 3 years, without severe competition. If necessary, treatments may be repeated 3 to 4 years after pine seedlings are established, to keep hardwood competition in check.

Prescribed Burning

Two or more annual burns before harvest provide good seedbed conditions and a high degree of hardwood control. A single burn following harvest has the same result, but there is always the danger of burning up the seed trees if logging slash (broken limbs and other debris left after harvest) is unusually heavy. To minimize seed tree damage, remove all slash near seed trees. The after-harvest burn should be carried out no sooner than 2 months before seedfall. The area should be checked before burning, to be sure that adequate seed or seedlings are not already present.

Prescribed burning is a good tool for site preparation and at the same time, improves wildlife habitat. Burning sets back woody plants, making new sprout growth available for deer. Burning also stimulates seed germination and growth of valuable herbaceous plants, making their seed more available to birds by removing litter accumulation.

Chopping, Disking and Dozing

Limit the use of heavy machinery to the more difficult sites — those with extensive hardwood or other plant competition, to sites with a dearth of seed trees, or those that are extremely dry — or sites with hard-to-regenerate species. If precautions are not used, too dense a stocking may result. In dozing, a shearing blade is preferable; unless skillfully used the straight blade or root rake removes too much topsoil, reducing site quality. Chopping, combined with a herbicide and/or burning, generally will suffice.

ADVANTAGES AND DISADVANTAGES OF NATURALLY REGENERATING PINE

When compared to clearcutting and planting, natural regeneration has numerous advantages and disadvantages. The advantages include:

- Lower establishment cost
- Less labor and heavy equipment required

- No problem with geographical origin of seed
- Reduced tip moth damage
- Better early root system developed by natural seedlings
- Selection management more practical with this system
- Less immediate visual impact
- Less soil movement

The disadvantages include:

- Less control over spacing and initial stocking
- Longer rotations needed
- Risk of seed tree loss
- Generally lower yields
- No use of genetically improved or disease resistant stock
- Loss of a year or more of growth because of failure to regenerate promptly
- Need for precommercial thinning in many stands to obtain good growth
- Limited use in pulpwood rotations because of low seed production from dense, young stands
- Irregular stands are not well suited for mechanical harvesting
- Poor access for fire equipment

Natural Regeneration Guide[1]

Situation	Species	What to do
Well-stocked stand. to be managed in even-aged units,	Loblolly, shortleaf and slash pine	Starting at leeward side clear-cut strips about 200 feet wide.

[1]Intended only as a quick checklist. In many cases, you have more than one alternative; decisions must be made based on the individual site and the owner's preferences.

Natural Regeneration Guide[1], continued

Situation	Species	What to do
while making periodic cuts.		Burn strips after the fuel is cured and before next seedfall.
Well-stocked stand, to be managed in even-aged units. Periodic cuts not required in the immediate future	Loblolly, shortleaf and slash pine	Use seed trees. For loblolly, seed-in-place and seedling-in-place also can be used.
Well-stocked stand; owner wants to manage forest as all-aged units while making periodic cuts.	Loblolly and shortleaf pine	Harvest groups of trees periodically to create openings for regeneration. May be able to prescribe burn for seedbed site preparation in some cases. Treat hardwood brush or inject unwanted trees, as needed, with herbicide to free young pine from competition.
Mature, slow-growing, or sparse pine stands.	Loblolly and shortleaf pine	Cut back to seed trees. Burn before seedfall in a good year. Remove seed trees when the young pines are 1- to 3-years old.

Natural Regeneration Guide[1], continued

Situation	Species	What to do
Understocked or mature stand.	Longleaf pine	Cut back to shelterwood of 30 square feet of basal area per acre. Remove when seedlings are established.
Stands of seed-bearing size.	Virginia pine[2]	Use even-aged management only. Clearcut in alternate or progressive strips using seed trees for final strip.
Scattered sawlog pine. Heavy understory of hardwood brush.	All pine species.	Chop and burn when debris is dry, or spray with herbicides in May or June. Burn in late August or early September.

[2]Grow Virginia pine only for short rotations because of its limbiness and susceptibility to heart rot. Avoid thinning it because of potential wind and ice damage. Under some conditions, light thinnings starting at an early age may be used to develop a sawtimber stand. If large products are desired and the site is good, consider conversion to other species.

PLANTING THE SOUTHERN PINES

Most of the successful regeneration of southern pine is accomplished by planting seedlings. Planting, however, is not without it's pitfalls. Success depends on these steps: Combine the right species with the right site to achieve the best growth and survival; plant at the right time; follow time-proven steps throughout the planting process. Following recognized guidelines is important to the land manager, professional forester, vendor, or any landowner who plans to invest in tree planting.

Five Crucial Phases

1. Obtain professional advice for local conditions.

2. Choose the right species and the best adapted geographical seed source.

3. Plant quality seedlings.

4. Protect seedlings from excessive heat and loss of moisture, from the time you get them from the nursery through all steps in planting.

5. Plant trees in the proper manner.

These are five crucial links in the tree-planting chain. Ignore any one of these links and you will unnecessarily risk your investment.

What Trees to Plant — And Where

The next decision is to select the tree species. Your choice will depend to some extent upon the soil and location of the planting site. Remember, the biggest mistake made in tree planting has been to plant the *wrong species* on the site to be regenerated. See figure 8 for general guidelines for planting pines.

Seed Source

After choosing the species, the seed source must be considered. If the wrong seed source is used, profits may be reduced or disappear because of poor survival or slow growth of the seedlings. Seedlings bought in one State may — or may not — grow successfully in another State. Before considering such a step, check a seed source guide.

Select the species best suited for the site, to produce the desired product(s) within an acceptable rotation length. Remember, if Virginia pine or sand pine are planted, pulpwood will likely be the principal product.

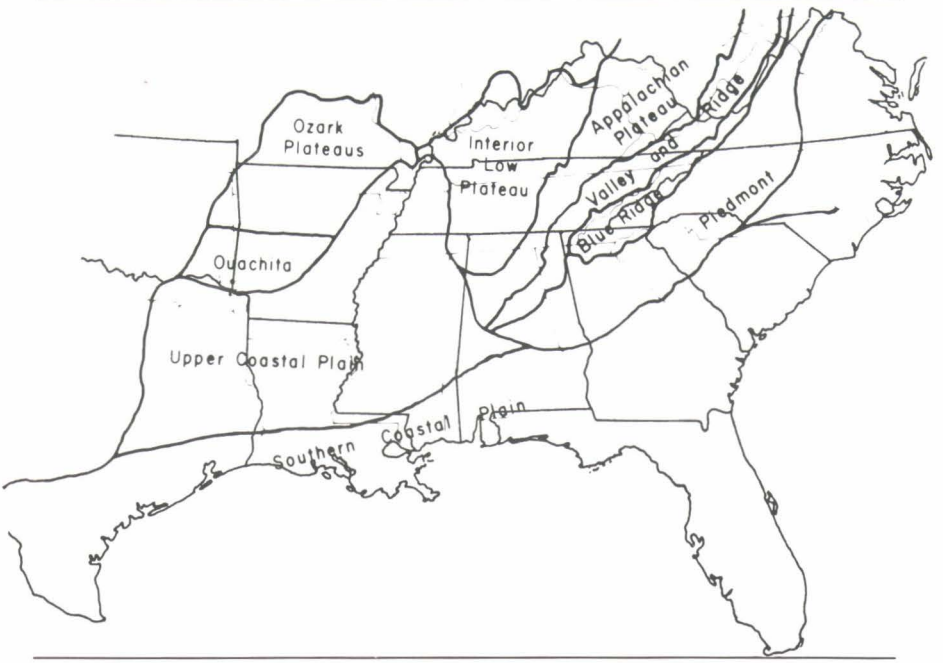


Figure 8. – Species-site guide for planting southern pines.

Genetically improved seedlings are being produced in steadily increasing numbers; consider their use when possible.

Improved seedlings can be expected to increase yields, as well as improve the quality of the wood and resistance to disease.

Insects and Diseases

Fusiform Rust. — This is the most important disease of loblolly and slash pines. In areas where fusiform rust is a problem, consider planting rust resistant stock. You may also choose species least susceptible to rust, such as longleaf, shortleaf, Virginia and white pine. Cultivation and fertilization increase growth in slash and loblolly pines, but also increase their susceptibility to fusiform rust.

Littleleaf Disease. — This is a major problem with shortleaf pine and, to a lesser extent, loblolly pine in Alabama, the Piedmont of Georgia, North Carolina, South Carolina and Virginia, as well as parts of Mississippi and Kentucky. See figure 9. Until disease-

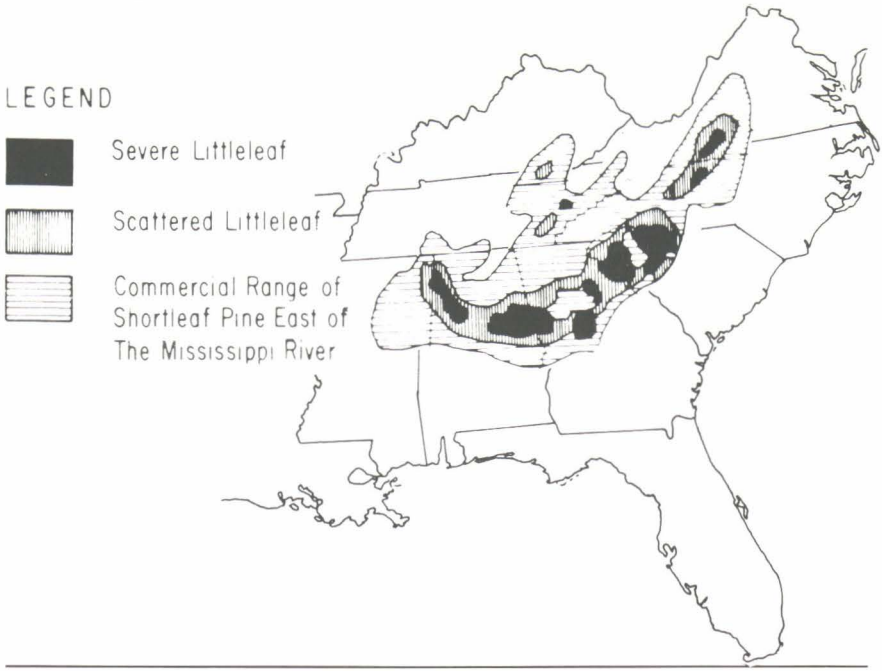


Figure 9. – Areas where littleleaf disease of pines are most likely to be a problem.

resistant planting stock is available, favor loblolly pine in areas where littleleaf disease is a problem.

Annosus Root Rot. — This disease kills many trees in thinned stands, in some areas. High-hazard sites are those with 12 inches or more of sand over heavy clay. Low-hazard sites have poor internal soil drainage, high seasonal water tables, or a depth to clay less than 12 inches. The disease is more common and severe on old-field sites. Preventive measures on high-hazard sites include planting at a spacing wider than 8 by 8 feet to reduce frequency of thinning; sprinkling powdered borax on fresh stump surfaces; and, in locations south of 34 degrees north latitude[3], thin your stands during the hottest months (May through August) except when bark beetles are a potential problem.

Brown Spot Disease. — This can be a major problem with longleaf pine, particularly in areas from southwestern Alabama to

[3]Includes most parts of the Gulf States, Georgia, South Carolina, lower part of Arkansas, and southeastern North Carolina.

the western tip of the longleaf range in Texas. A prescribed fire is a good way to control brown spot in plantations if infections are heavy. The systemic fungicide, benomyl, can be used as a seedling root treatment to control brown spot in field plantings. Brown spot resistant strains of longleaf pine are being developed and should soon be available.

Southern Pine Beetle. — This insect has killed many pines throughout much of the South. The beetle attacks primarily loblolly and shortleaf pine stands that are under stress from drought, overstocking, poor drainage, disease, storm damage, or logging damage. Good stand management offers the cheapest, most practical, and longest lasting means of control, especially where beetle epidemics occur frequently. Recommended preventive measures include matching site and planting stock; thinning overstocked stands; promptly salvaging lightning-struck, diseased or damaged pines. Take care in the use of equipment in forests, including road construction; and when harvesting all mature trees.

Pales Weevil — This is the worst insect pest of pine seedlings on recently cutover pine lands. In problem areas, apply an insecticide if suitable chemicals are registered for this use in your State (check with your State forestry agency for current information). Otherwise, delay planting for one season following harvest cutting. If the southern pine beetle is a problem in your area, consider planting slash pines rather than loblolly, within the natural slash pine range.

What is a Quality Seedling?

A quality seedling is one that is easily planted, disease free, and meets the following standards:

- Root collar diameter: No less than 3/8 inch for longleaf pine and 1/8 inch for others.
- Stem: Stiff and woody with secondary needles present.
- Top length: Maximum of 14 inches for all species.
- Root systems: No less than 6 inches nor more than 9 inches long.

Transporting, Handling and Storing Seedlings

Once a quality seedling is produced at the nursery, only half the battle is won. From the time a seedling is lifted from the nursery bed until it is safely planted in the field, the greatest danger to its life is too much root exposure to the sun, wind, or just dry air. Do not expose roots to the sun or wind for more than 10 minutes.

Avoid hauling seedlings for long distances in open trucks, particularly in warm weather, to prevent overheating and drying. Freezing can also kill seedlings. Heavy damage can result if seedlings are separated while they are frozen. If time is a factor, immerse frozen bales in cool water before separating the seedlings.

After receiving seedlings from the nursery, immediate planting is not always possible, so some method of storage must be planned. Whatever the method used, stickers (1 by 2 inch or wider boards) must be placed between stacked packages to allow air to circulate and prevent heating.

Cold storage is the best method. Dormant seedlings can be held at temperatures from 32° to 40°F, for as long as 10 weeks if packed in standard Forest Service bales, and 12 weeks if in kraft-polyethelene (k-p) bags. Plant non-dormant stock first.

If cold storage facilities are not available, seedlings may be stored in a warehouse or on shaded racks, but the seedlings will need special attention. If seedlings are packed in standard Forest Service bales with wet media, watered upon receipt and bi-weekly thereafter, they can be stored up to 8 weeks. At the same time, they must be protected from heat and subfreezing temperatures. If seedlings are packed with a clay slurry dip, no watering is needed. If packed in k-p bags, seedlings can be stored up to 8 weeks, provided they are encased in wet packing or a clay slurry dip. Otherwise, 4 weeks is the maximum storage time. K-P bags should not be watered.

Plant sand pine seedlings within 1 week after they arrive from the nursery. Bales or packages of sand pine seedlings should not be stacked in storage.

Site Preparation

In some cases, it pays to reduce or eliminate competing vegetation before planting. Weigh the initial costs of treatment against future returns. Too intensive a treatment may be uneconomical, even though an increased volume results. Too intensive a treatment may actually decrease site productivity. On droughty soils with limited organic material, intensive site preparation may increase survival at the cost of later growth. Ideally, site preparation reduces competition without removing or destroying top soil and organic matter.

Disking and furrowing are most successful where heavy sod is present. When performing these operations:

1. Do not plant in furrows where the water table is close to the surface. Water standing in the furrows or very close to the surface inhibits root growth and may kill the seedlings.
2. Do not furrow light sandy soils. Survival usually is improved but, because top soil is removed, long-term growth may lag.
3. Always install furrows on contours to reduce erosion. For the same reason, avoid disking slopes of 10 percent or more.

In light sod, disking and furrowing are not usually needed. A scalper on the tree planter removes grass competition and clears trash from its path in one operation.

A rolling drum chopper can effectively reduce woody competition with minimal soil disturbance. Large choppers are usually more effective than small ones; two choppers in tandem are more effective than one. If trees are scattered or too large to chop, treat them by other methods.

Shearing or KG blading is often the best way to remove large numbers of stems that are too large to disk or drum chop. With care, little soil is disturbed and most debris that would hinder planting is removed. If debris is piled in windrows, allow frequent breaks for access by planting equipment and firefighting equipment. Large piles and windrows of debris deteriorate slowly. They also occupy more planting site and result in greater loss of top soil through pushing of material farther across the ground. Keep the aisles and windrows as narrow as possible. Hand planting usually eliminates the need to windrow or pile debris.

Rootraking and bulldozing can also be used to remove trees and shrubs. Disadvantages of these techniques include excessive soil disturbance, and considerable topsoil often ends up in the windrows.

Apply chemicals for individual stem treatment or on larger areas. No soil is disturbed and litter is not destroyed. When chemicals are used alone, machine planting is not practical unless hardwoods are very small.

Individual tree release is best suited to smaller tracts in areas of abundant labor. Release is usually accomplished immediately after planting, by injecting a herbicide or by felling competing trees, with herbicide applied to the stumps.

Foliar use of herbicides by equipment on the ground or aircraft is usually the cheapest and fastest method of hardwood control. However, use these methods only when there is no hazard from drift. Be sure to contact your State forestry agency for the latest information on herbicide usage.

Prescribed fire is a valuable supplement to some forms of mechanical or chemical control of competing vegetation. Other benefits are improved access and visibility, which increase efficiency and safety of planting operations. Drum chopping and fire, used in combination, is one of the most effective and least destructive methods of intensive site preparation. Some drawbacks of prescribed fire are: local or State laws on smoke management may prevent burning during part of or all of the year, or on sites with minimal litter present; fires may be erratic when used alone; fire will seldom provide lasting benefits; and *fire must be used skillfully for safe and effective results*.

Caution: When conducting any practice that disturbs the soil, leave undisturbed strips along streambanks to filter out sediment. Strips should be 25 feet wide plus an additional 2 feet for each 1-percent increase in slope.

Planting Methods

There are two options: to plant by hand or with machines. If the site is a vast, open expanse, machine planting is by far the more economical method, enabling the same crew to plant four to five

times more trees per day than in limited areas. Hand planting is more efficient on small areas, where the terrain is very rough, or where numerous stumps, debris or large diameter hardwoods impede the use of machines. See figure 10.

Hand Planting

Three tools are essential to the hand planter: (1) a dibble or planting bar; (2) planting bag for carrying seedlings; and (3) wire cutters, if seedlings are bound with steel straps. Figure 10 shows the procedures for hand planting:

1. Insert the dibble at an angle to the depth of the blade. Push the dibble forward to open the hole (don't compact the soil by rocking the dibble back and forth).

2. Remove the dibble and insert a seedling deeply in the hole, then withdraw the seedling until its root collar is at, or slightly below, the ground level and the roots are straight.

3. To hold the seedling in place, insert the dibble part way into the ground 2 inches behind the hole, then push and twist the dibble forward, closing the top of the planting slit.

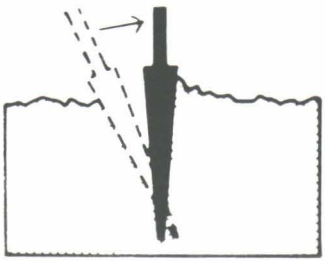
4. Push the dibble straight down to the depth of the blade.

5. Rock the dibble backward and forward to pack the soil firmly against the root.

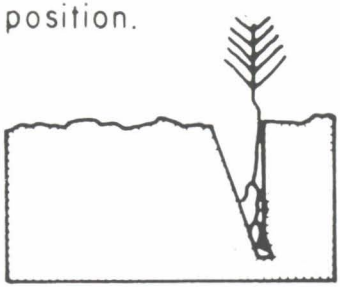
6. Fill in the last hole by firming it with your heel.

Planting Time

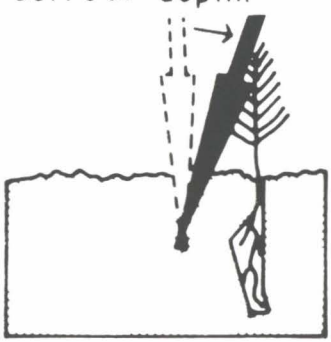
For conventional bare root seedlings, the most favorable time to plant is during the dormant season. (The season can be extended from 2 to 4 weeks by placing dormant seedlings in cold storage.) Avoid planting when the ground is hard — either frozen or dry — or when too wet or sticky. Planting when the soil is in poor condition



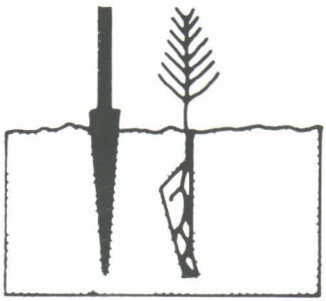
1. Insert dibble at angle shown and push forward to upright position.



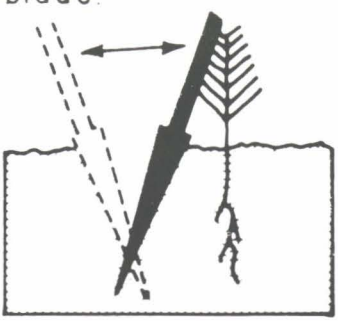
2. Remove dibble and place seedling at *correct* depth.



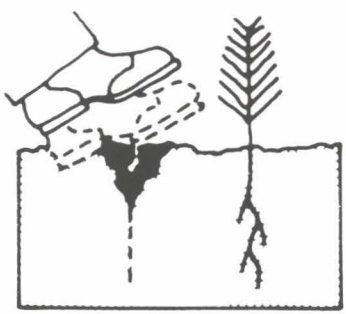
3. Insert dibble part way, push and twist forward closing top of planting slit.



4. Push dibble straight down to depth of blade.



5. Rock dibble back and forth to pack soil firmly against root.



6. Fill in last hole by stamping with heel.

Figure 10. – Guide for planting southern pines.

results in low survival, poor planting production, misplanted seedlings, and poor growth.

Spacing

Before ordering seedlings, decide what spacing to use. No standard spacing can be recommended because of differences in site quality, local survival pattern, products desired, or other factors. For most situations in the South, spacings of 7 by 9, 7 by 10, 8 by 8 and 8 by 9 feet (600 to 700 trees per acre) have many advantages over closer spacings because they:

- Are much cheaper (about half as many trees are needed with 8 by 9 foot spacing as with 6 by 6 foot spacing, for example).
- Produce about the same volume of wood in 20 years on fewer trees, increasing the end value.
- Enable you to delay a decision on the product objective — pulpwood and/or sawtimber — without a large financial penalty. You can therefore hedge against market changes during the 15 or 20 years after planting.

At the same time, the advantages just described must be balanced against those of closer spacing which:

- Produce a greater volume of wood in the first 20 years.
- Provide more insurance against poor survival caused by poor site quality and losses from insects and diseases.
- Provide an opportunity for an early return from thinning.
- Produce a higher quality tree.
- Make better use of good sites.

One precaution: With any spacing, some rows should be spaced 10 to 12 feet apart at regular intervals to provide access for fire-fighting and harvesting equipment.

Wider spacings may be desirable when you want to grow larger products as fast as possible, or to grow slash or longleaf pines for naval stores.

Machine Planting

Specific planting machines are not recommended because conditions vary throughout the South. Fortunately, a variety of good machines are available; one or more of them will be particularly suited to your area. See figure 11.

Figure 11. – Machine planting.

Protecting seedlings from drying out during machine planting is just as important as it is when planting by hand. Keep the seedlings covered and the roots moist.

As in hand planting, check frequently to assure that the seedlings are being planted properly. Key points include: (1) proper depth of the trench; (2) correct tracking of the packing wheels; and (3) proper closure of the trench by the packing wheels. Check root placement by opening one side of the trench with a shovel to expose the seedling in place.

Planting Followup

To check survival, randomly select some planting areas to be sampled. In March or April following planting, grid each tract selected with ten 1/100-acre plots (a circular plot with a radius of 11.8, or a square plot 20.9 feet to the side). Mark the center of each plot with a stake, locate the plot on a map, and flag each planted seedling. In the fall return to the plots and count the surviving trees. Multiply the total by 10 to find the average seedling survival per acre.

As a rule, if 300 or more well distributed seedlings survive per acre, it does not pay to replant. If average survival is less than 300 seedlings per acre it may be best to clear the remaining seedlings and start over. Decisions to replant will vary, depending upon replacement costs and estimated stumpage values.

When checking survival, periodically re-evaluate the need for release of seedlings from competing hardwoods. Many plantations have survived well the first year, only to fail later because of overtopping competition.

DIRECT SEEDING

Direct seeding can be an effective practice for regenerating the southern pines. On many sites, direct seeding is more economical than planting nursery-grown seedlings or waiting for natural reproduction. Direct seeding may be the best choice on some sites where access, terrain, or drainage conditions make planting difficult. Discovery of effective bird, rodent, and insect repellents has made

direct seeding possible and practical, although the process requires a high degree of technical skill and knowledge. The key to success lies in obtaining the advice and assistance of an experienced direct-seeder.

Advantages and Disadvantages

The choice of a method of regeneration depends on your goals and economic situation, as well as the capability and condition of the site. The advantages of direct seeding include:

- Lower initial costs
- May require less site preparation
- Less labor and heavy equipment needed than for planting
- Natural root system - no L, J, or W shaped roots
- Easier to apply on remote or inaccessible areas
- Flexibility - may be able to regenerate quicker following fire or other disasters.
- Easier to regenerate large areas quickly
- Easier to regenerate some hard-to-plant species

Disadvantages of direct seeding include:

- Less control over spacing and stocking
- Longer rotations needed
- As a rule, lower yields
- Little opportunity to use seed from disease-resistant or genetically improved sources

- Loss of a year's growth
- May need precommercial thinning
- Irregular stands not well suited for mechanical harvesting
- More difficult access for fire equipment
- Seed washing on steep slopes results in loss of seed or uneven distribution.

When to Use Direct Seeding

Increasing planting costs, a growing shortage of labor, the need for prompt restocking of forestland, and the sheer magnitude of the regeneration job facing the South make direct seeding worthy of consideration. Direct seeding can be used to regenerate open lands and, with site preparation, it is effective on land partly or wholly occupied by brush or low-value hardwoods. Generally, any plantable area is suitable for direct seeding. Exceptions include deep sands that dry rapidly, and excessively wet soils unless they are bedded. As a general rule, consider direct seeding if site preparation costs are low; plant seedlings if site preparation costs are high.

Species Selection

Choose the species that will meet your objectives; probably a species superior in growth and yield. In general, grow loblolly in the Piedmont and upper Coastal Plain where the terrain is rough and hardwood competition severe. Slash pine grows best in the southern Coastal Plain flatwoods; longleaf pine on areas where it formerly grew; shortleaf or Virginia pine in the northern reaches of the South that are too cold for loblolly; and sand pine on the deep sandy areas of Florida and south Georgia.

Thorough site preparation is essential to expose the mineral soil that pine seeds need for germination, and to control competing vegetation that interferes with the survival and early growth of the

new stands. Methods described under planting also apply to direct seeding.

Seed Handling and Treatment

All seed should be treated by trained workers to provide a high degree of protection from seed-eating birds, mammals and insects. Because some chemicals are toxic, directions for safe handling should be followed carefully.

Time of Year — Sow longleaf pine seed in the fall after natural seedfall, and when the soil moisture has been recharged by 2 to 4 inches of rain, or in the early spring. Sow loblolly, shortleaf, and slash pine seed in the spring about the time the first blooms appear on redbud and red maple. Normally, in the spring, prolonged periods of freezing weather are past, soil moisture is adequate, and daily temperatures reach levels needed for germination. Stratified seeds sown in mid-February usually complete germination by mid-April, though prolonged cool weather or drought can extend germination into May.

Follow-up

To be sure that adequate numbers of seedlings are present, make a field check at the end of the first growing season. A check early in the summer is also a good idea to determine germination success. The difference between the two inventories reflects the first summer mortality and will be useful information for seeding similar areas. To sample broadcast areas for a probable accuracy of ± 20 percent, stake out a grid of 25 mil-acre plots (radius 3 feet, 8.7 inches). Count the number of seedlings on each plot and multiply the average by 1,000 to get the number of seedlings per acre. Stocking is the percent of mil-acres with at least one seedling present. When numbers per acre are between 1,500 and 3,500 the usual range of stocking is between 60 and 80 percent. A widely accepted minimum criterion for success is 55 percent. Should the stocking be less than 55 percent, wait another year and take another inventory before regenerating by reseeding or planting. Some areas have been seeded twice, unnecessarily. Eight out of 10 seedings are successful.

Areas with 2,000 or more seedlings per acre at the end of the first growing season should be reinventoried at age three. If there are then 1,500 or more live seedlings per acre, the area should be given a precommercial thinning promptly for yields to approach the yields from plantations. Some seeded areas may need release from hardwood sprouts by chemical sprayings.

REGENERATING HARDWOODS NATURALLY

Sources of Regeneration

On most hardwood sites, natural regeneration will be sufficient to replenish the stand. Go through a stand before the harvest cut to see if you can expect to have enough seedlings, seedling sprouts, root sprouts, or stump sprouts of the desired species to develop into an adequately stocked stand once the overstory is removed. Tolerance of species to shade, and whether the species is heavy or light seeded, will govern the steps to be taken to start a new stand.

Intolerant, light-seeded species such as yellow-poplar, ash, and cottonwood will regenerate themselves from seed if the seedbed conditions are favorable and sunlight is available. Seed from species such as yellow-poplar and ash remain viable on the forest floor for several years and are usually plentiful if these species were present before harvest. Also, birds, animals, and wind transport seeds from nearby stands. Logging acitivity is usually sufficient to scarify the forest floor and provide the mineral seedbed needed for germination. Removal of the overstory and brush will enable sunlight to reach the forest floor, helping the light-seeded species to germinate and grow fast enough to compete with other plants. Usually, seed trees need not be left on hardwood sites.

When regenerating heavy-seeded species of intermediate shade tolerance, such as the oaks, well established seedlings should be in the understory at the time of harvest. These seedlings develop after germination under the shade of the forest canopy. Many seedlings die quickly, others die back and resprout, but some endure under closed canopies for several years, and are called advance regeneration. Their top growth may be very slow, but the root system continues to develop.

Advance regeneration is particularly important for oaks because new seedlings are produced sporadically, and grow too slowly to compete successfully with other species. Oak saplings, 4 to 5 feet in height, with well developed root systems, are most desirable as advance regeneration. These young trees will respond quickly and vigorously to sunlight after the harvest cut, and should grow fast enough to compete with other species. Logging usually does not harm advance regeneration because sprouts will grow vigorously from the root collars of saplings and seedlings that are broken or cut during harvest.

Young hardwood stands almost always contain some stump sprouts, and occasionally entire stands can develop from stump sprouts. Because of their vigorous early growth, stump sprouts often dominate other forms of reproduction. The quality and longevity of trees resulting from stump sprouts are sometimes questioned, but stems that start from small stumps below or near the ground line are usually good risks. Stump sprouts from yellow-poplar often produce the best trees in the stand. Most hardwoods also produce root sprouts. Species such as black locust and sassafras produce them prolifically and may regenerate almost entirely from root sprouts.

Cutting Methods

The total removal of the canopy in one cut, called clearcutting, is an effective and efficient method to naturally regenerate a hardwood stand. Clearcutting provides the best conditions for fast-growing, shade-intolerant species that need full sunlight to develop rapidly. Some shade-tolerant species also do well under these conditions. Total canopy removal results in an even-aged stand.

The commercial timber harvest will remove much of the canopy — and the cleaner the logging job the better. In most cases, however, culls, low quality trees, undesirable species, and some small trees will be left. Cut or kill these remaining trees so they will not impede regeneration. You may control this unmerchantable material by several methods. A combination of felling and herbicide injection could be used. Trees of desirable species that produce sprouts could be felled, and undesirable species could be injected. Undesirable

trees may be controlled before or after the commercial logging operation. The method and timing are less important than making sure that unwanted trees are treated, especially stems larger than 4 inches in diameter.

In some stands, grapevines may interfere with seedling growth. Grapevines are intolerant of shade and, if cut 3 to 4 years before the timber harvest they should not be a problem in the new stand.

The size of the regeneration opening depends on your overall management objectives. Areas as small as ½ acre can be used, but development of such small tracts will be impeded by side competition and over-browsing by deer. Also, such small tracts are inefficient to manage. Openings several acres in size usually can be managed more efficiently and with fewer residual trees affected by degrade on the edge of the openings.

Good hardwood regeneration has developed from the shelterwood regeneration method. A series of treatments are involved: (1) partly cut the overstory to leave 50 to 60 square feet of basal area per acre, (2) cut, or inject herbicide in the unmerchantable understory trees at the time of the first cut, (3) a few years after the first cut, make a secondary cut — which would be a final harvest cut if regeneration is satisfactory, or cut the stand back to 40 to 50 feet of basal area again if regeneration needs to develop further under shelter. In the latter instance, a third, final harvest cut would be made.

The shelterwood method also produces an even-aged stand. The sources of regeneration can be the same as in a clearcut, but they depend somewhat less on seed and seedlings already in place before any cutting is done. In most cases, leaving a shelterwood has few biological advantages, but it can be used to help develop advance regeneration.

The shelterwood method of regeneration cutting should not be confused with the occasional removal of the biggest and best timber trees — or high grading. When you make partial cuts to regenerate a stand, treat unmerchantable understory trees, and remove the remaining overstory when regeneration reaches a satisfactory stage. High grading produces neither of these goals and badly detracts from long-range growth potential.

Removal of single trees scattered throughout the stand, as a regeneration method, generally has not proved to be an effective way to regenerate the hardwoods of the South. Most desirable southern hardwoods have little tolerance of shade. They will begin to develop under partial shade, but they should be released from overhead competition fairly early in life. The biggest drawbacks to single-tree selection are that the method fails to provide for quick and orderly removal of overhead competition and it promotes the development of shade-tolerant species, many of which are not desirable.

PLANTING HARDWOODS

Hardwood seedlings account for about 1 percent of the total seedlings produced in southern nurseries. The highest species production is for black locust, sycamore, cottonwood, eucalyptus, sweetgum, black walnut, yellow-poplar, green ash, white ash, and water-willow oak.

Black locust is planted primarily for erosion control. The rest are planted most often by industry on clean tilled land where they are cultivated two to four times during each of the first 2 years in the field.

Black walnut and yellow-poplar are the two preferred species for planting on small ownerships in the Piedmont, the extreme upper Coastal Plain and farther north. Both species are quite site specific. Fastest growth occurs on stream terraces, in coves, and on lower north- and east-facing slopes. The soil should be deep, fertile, and well drained. If yellow-poplar trees of seed bearing age were present in the harvested stand, then planting is usually not necessary.

Hardwood seedlings should be large, with a root collar diameter of at least ⅜ inch, a live terminal bud, and a well developed root system. Black walnut and yellow-poplar can be planted with a bar or mattock, taking care to avoid doubling or twisting the roots. Control herbaceous plants until the tree seedlings have outgrown the weeds. Inject woody plants with a registered herbicide. Planting on a spacing of 10 by 10 feet permits cross cultivation where feasible. Yellow-poplar will prune itself at such a spacing unless many of the seedlings die. Start pruning the black walnut when it is about 5 years old.

The three most important points to remember when planting hardwoods are: (1) Selecting the planting site. Be sure that the species is suited to the site. (2) Plant only large, healthy seedlings, with an adequate root/top ratio. (3) Be prepared to control competing plants until your tree seedlings are well established and free to grow.

Direct Seeding

Another option for establishing oaks is direct seeding of acorns. Research indicates that oaks can be successfully regenerated from properly stored acorns sown any month of the year either by hand or machine.

Good results are reported from sowing freshly collected or properly stored untreated acorns of Nuttall, cherrybark, Shumard, and water oaks. Nuttall consistently gives the best results.

Satisfactory results are generally expected from direct seeding these favored bottomland oak species if the following suggestions are heeded:

- Reduce animal predation by seeding 2-acre or larger forest openings or old fields relatively free of competing vegetation.
- Match species to site. Sow Shumard and cherrybark on well-drained sites. Sow Nuttall oak on heavy clay sites subject to flooding from January through mid-May. Water oak is more flood tolerant than cherrybark, but less than Nutall.
- Collect acorns soon after seedfall. They can be stored in 4 mil polyethylene bags at about 35°F. Red oak acorns can be stored up to 3 years, but should be tested for moisture content every 3 or 4 months. Red oak acorns should be kept at 40- to 45-percent moisture content.
- Acorns can be sown at any time of the year.
- A sowing depth of 2 to 3 inches is best.
- Sow acorns by hand or with modified mechanical agricultural planters.

- Sowing rate should be about 1,500 acorns per acre at a spacing of 10 x 3 feet to facilitate between-row weed control if needed. Even without weed control, direct-seeded oak will continue to grow if they have direct overhead sunlight.

INTERMEDIATE CULTURAL TREATMENTS FOR PINE

PRECOMMERCIAL THINNING

Many acres suffer from having too many young trees. These problem areas include sites that were direct seeded with too many seeds and those naturally reseeded either after a wildfire or after intensive site preparation. If the sites remain untreated, the time it will take the trees to become merchantable may be doubled. If the stand contains more than 1,500 seedlings of the preferred species, you may wish to thin it precommercially at ages 2 to 5. Precommercial thinning is needed particularly in dense stands of shortleaf and slash pine, because these species do not become dominant as quickly as loblolly and longleaf pine. Thinning is also needed on poor sites to promote early dominance by the desired species.

Hand thinning may be the only practical method on small tracts, but is usually too expensive or the labor is not available. When hand thinning, leave single trees 8 to 10 feet apart. Otherwise, use a bush-hog or brush cutter on saplings less than 5 feet tall. A heavy-duty chopper may be used for trees 5 feet and taller, but no more than 3 inches in diameter, cutting 8- to 10-foot lanes through the young stand. Keep the leave strips as narrow as possible. When successfully treated, the stand will appear to have been decimated.

THINNING

Once a planted or natural stand reaches pulpwood size, it is time to consider thinning to: (1) increase the rate of return on the forest investment by developing large trees that bring high stumpage prices, (2) obtain early returns to liquidate the establishment or cultural costs promptly, (3) provide periodic income, (4) salvage

trees that will soon die, (5) concentrate growth on the best trees, (6) provide better access for fire equipment, and (7) enhance wildlife habitat.

Factors governing selective thinning to obtain these advantages include size, quality, rate of growth, defect, spacing and species (in mixed stands). During the first thinning wait until the average tree to be cut is at least 6 inches in diameter, and the smallest trees to be cut into pulpwood have at least 10½ feet to a 4-inch top outside bark. If you do your own marking and your own harvesting, selective thinning has no peer. For many, however, row thinning in plantations or "road" thinning in natural stands is most practical because it makes mechanical harvesting possible and facilitates trucking, particularly for the first thinning.

Where the trees are not in rows, leave 15-foot strips of trees between cut swaths 10 to 12 feet wide. Remove selected trees from the leave strips. For plantations with 700 to 1,000 trees per acre, when fusiform rust is not a major problem (less than 20 percent of the stand infected), remove every third row. Limited selective thinning can be done in residual rows to upgrade the stand. Removal of every fourth row has several advantages: (1) selective thinning of the two remaining outside rows can be quite flexible; (2) diseased trees can be removed without diminishing the stand; and (3) row thinning can be used on the middle row the next time around if necessary.

For anyone familiar with basal area, a good rule of thumb is to cut back to 85 square feet on the better sites when thinning at 5-year intervals or when frequent thinnings are not possible; and to 70 square feet when the objective is to grow sawtimber on rotations of less than 40 years. A guide for thinning pulpwood-size stands is given in table 2.

PINE RELEASE CUTTING

Release, by definition, is the freeing of a tree from immediate competition by cutting or otherwise eliminating less desirable trees (generally, low value hardwoods) that overtop or closely surround the desired trees. The need will vary by species, site and past treatment. The problem is generally not as severe in the Coastal

Table 2. – Guidelines for management of pulpwood-size stands[1]

Situation	Clearcut	Let it be	Thin each:				
			Selection thinning	Alternate row	Third row	Fourth row	Fifth row or more
Disease severely infects stand	X						
Fire severely damages stand	X						
Trees grown only for pulpwood		X					
Owner does own marking and harvesting			X				
Marking services readily available; contractors in area are willing to harvest selectively-marked stands			X				
Slash stands of 1,000 or more trees per acre, and free of disease				X			
Plantations with 700 to 1,000 trees per acre, cronartium canker not a major problem					X		
20 to 50 percent of stand infected with cronartium canker			X			X	X
Ice and glaze damage is a major hazard			X				X
Wildlife is a major management objective					X		

[1]Intended only as a quick checklist. In many cases, more than one alternative is open to your choice. Decisions must be made on an individual basis.

Plain as in the Piedmont and mountains. Twenty or more years ago, many oak-pine and oak-hickory stands had an understory of young pine. Today, because of infrequent fires, pine seedbed conditions are poorer and competition from seedling and sapling hardwoods is greater. Periodically following a good seed crop the floor of oak-pine and some oak-hickory stands will be covered with pine seedlings.

Cutting or deadening overtopping, low value hardwoods will greatly increase the survival and growth of young pine seedlings as a result of increased light and greater availability of soil moisture. Although release during the seedlings' first year is preferable, release postponed as long as 8 years has been effective with loblolly pine. Less than complete treatment of hardwoods generally results in the need for a repeat release about 3 years after the initial treatment because of resuppression by hardwood sprouts, or by the spreading crowns of hardwoods not treated initially.

Release cutting is often the cheapest way to obtain a fully stocked pine stand. The treatment is effective with all four of the major southern pine species. Release cutting is also effective where stands are being managed for quality hardwoods, but the techniques are more selective and complex.

IMPROVEMENT CUTTING

In the cutover forests of the South about one-third of the growing space in pine-hardwood and hardwood stands is occupied by cull or low value trees — trees that, because of undesirable form, quality, condition, growth rate or species, should be removed to stimulate the growth of better trees. The feasibility of such a cut is determined by the amount and quality of the material to be removed, local market conditions, logging conditions, and the stocking of desirable trees that will be left following the cut.

An improvement cut is practical if, following the cut and associated deadening operation, at least 40 to 50 percent of the area will be stocked with desirable trees. Local market and logging situations will determine how many trees will need to be cut to interest a buyer.

Examples of trees that should be removed include:

1. Badly suppressed trees, which are certain to go out of the stand within the next 5 years through natural mortality.
2. Trees having crooked trunks that will never produce sawtimber.
3. Trees that show unmistakable evidence of heart rot or other tree-destroying fungi.
4. Trees that contain fire scars or other injuries so severe that they are susceptible to wind damage.

Improvement cuts will pay off in increased growth of higher quality wood and reproduction of desirable species. Such cuts also make use of a large volume of timber that would otherwise die of natural causes or decrease in quality before the next cut.

PRUNING

Pruning is profitable only when premium prices are offered for higher quality logs. Early pruning will restrict the knotty core. No more than 75 crop trees per acre should be pruned. Pruning should leave about 50 percent of the trunk in live crown; more severe pruning may interfere with rapid growth of the crop trees. Limbs should be pruned when they are small, without leaving a stub, to ensure rapid overgrowth of the knot. Wounds heal faster if the limbs are pruned close enough to the trunk of the tree to cut the living cambium (the layers of tissue closest to the bark) at the branch node. Confine pruning to trees on the good and better sites. Thin repeatedly and heavily to release the pruned trees from competition, to obtain highest profits from pruning. Before investing in pruning, find out if an appropriate increase in stumpage prices can be expected.

HARDWOOD CONTROL TECHNIQUES WITH HERBICIDES

Forest landowners manage their forests for many reasons: timber, wildlife, clean water, recreation, aesthetics, and, in some

cases, protection of threatened and endangered species. On private nonindustrial forestland and publicly owned forests, the trend is moving from intensively managed, single-species, even-aged stands to mixed, and all-aged stands. No longer are hardwoods considered a nuisance in all pine stands. To promote biological diversity within the forest, fruiting crop trees are often encouraged and hard mast species such as oaks and soft mast species such as cherry and dogwood are selectively favored. The judicious application of forestry herbicides can be used to control the spacing of crop trees and to change species composition. Success depends upon selection of the proper herbicide, the method of application, and application at the appropriate rate and the correct time of year. Herbicides, when properly applied, are cost-effective and environmentally safe. What follows is a summary of the various treatments, application methods, and herbicides currently used in the South:

Cut-Surface Treatments

These methods are generally used to eliminate large unmerchantable trees. The main advantage of these methods is that very little equipment is required. A disadvantage, however, is that when the overstory trees are removed, many of the small understory hardwoods and shrubs flourish, resulting in heavy competition with pine seedlings.

Cut surface treatments can be used any time of the year; however, some herbicides work better than others during the growing season.

1. Tree Injection

Tree injection works best on sites where the target species for control are widely scattered and have stems 2 inches d.b.h. and larger.

The usual methods of application employ either a tubular tree injector or hack 'n squirt. One milliliter (1 mL) of the herbicide is usually applied to each cut with either of these methods.

Typically, the tubular tree injector is a self-contained unit using a chisel type blade to cut through the tree bark and into the

vascular system near the base of a tree. The unit is equipped with a wire release or handle that is pulled to deliver the herbicide into the cut.

The hack 'n squirt method involves only the use of a hatchet and a squirt bottle. The hatchet is used to cut through the tree bark into the sapwood, and the squirt bottle is then used to apply the herbicide into the cut. The squirt bottle usually holds about a quart. A household squirt bottle may be used, but it is *not* durable. Most commercial applicators prefer a commercial squirt bottle available from automotive parts suppliers, or a pesticide spray bottle available from plant nurseries, equipment suppliers, or feed and seed stores. These bottles apply about one milliliter per squirt. To apply, a person grasps the hatchet in one hand and strikes the tree at about waist height, cutting through the bark into the sapwood. With the squirt bottle in the other hand, the herbicide is applied to the cut after the hatchet is removed. See figure 12.

2. Frill or Girdle Method

This method involves completely cutting the tree into the sapwood with an ax or hatchet. The cut surface is then completely wetted with the herbicide using a squirt bottle or a small pressurized spray unit.

3. Cut Stump Treatment

In this method, freshly cut stumps are thoroughly sprayed with the herbicide along the outer rim of the stump, to a depth of about one inch, to prevent sprouting. A pressurized backpack sprayer is usually used with this treatment.

Some of the commonly used herbicides for injection hack 'n squirt in the South are Garlon 3A, Tordon 101R, Tordon RTU or Pathway, Roundup or Accord, 2,4-D Amine and Arsenal AC. Herbicides used on freshly cut stumps include 2,4-D Amine, Garlon 3A, Tordon 101R, Tordon RTU or Pathway, Weedone CB, and Arsenal AC.

Directed Foliar Spray Applications

This technique is primarily for release of first and second year pine stands when the hardwood competition is less than six feet high. Caution must be taken to direct the spray away from pine foliage.

The herbicide is usually applied with a backpack sprayer and a hand spray gun using either a flat or an adjustable spray-tip. The spray is directed on the target foliage including the growing tips. Pine crop trees should not be sprayed since they might be injured or killed. See figure 13.

Some commonly used herbicides for this method are Garlon 3A, Garlon 4, Arsenal AC, Accord or Roundup, and Weedone 2,4-DP.

Basal Applications

1. Full Basal

Full basal treatments are usually applied to stems up to 6 inches in diameter. The lower 12 to 20 inches of the stem are completely wetted with the spray mixture on all sides.

The herbicide mixture is usually applied with a diaphragm pump backpack sprayer and a spray gun or spray wand with a narrow angle flat fan spray tip or an adjustable spray tip.

Some of the commonly used herbicides in the South that are applied (mixed with mineral oil or diesel fuel) are Garlon 4, 2,4-D Ester, Weedone 2,4-DP, Weedone CB and Chopper.

2. Streamline Basal

This treatment is for controlling young stems 2 inches d.b.h. or smaller. It is used primarily in mixed or uneven-aged stands and in pure hardwood stands. It is often used in combination with injection or hack 'n squirt. The application is usually done during the dormant season. The herbicide is applied with a backpack sprayer to small stems in a 1½- to 2-inch band to one stem side in a back-and-forth swinging motion about 10 to 20 inches above the

base of the plant. An hour or so after application, the wet, treated area on the stem should have spread 6 to 10 inches down the stem and should completely, or almost completely, encircle the stem. Stems that are beyond the juvenile stage, heavily barked, or nearly 2 inches or more in diameter may require treatment on both sides of the stem.

This method employs a diaphragm pump backpack sprayer equipped with a gunjet. The most common herbicide mixture is 20 percent Garlon 4, 10 percent Cide Kick (a penetrant/wetting agent), and 70 percent diesel fuel or mineral oil. See figure 14.

Soil Spot Applications

These methods apply a soil-active herbicide directly to the soil rather than to the target plant species. They can be used for single stem treatment or they can be applied in a "spot grid." Velpar L is the most common herbicide and the application rate depends on soil texture and species you wish to control. Less is used on sandy soils, more on clay soils or soils with a high organic matter content.

1. Spot Grid Application

This treatment is commonly used on sites with many stems per acre. Spots of herbicide are applied directly to the soil in a regular pattern. One commonly used pattern is the 3x3 foot grid with 1 milliliter (mL) undiluted Velpar L or equivalent applied per spot. The dimensions of the grid are determined for each situation based on the kinds of vegetation to be controlled and the soil type on the site. See figure 15.

2. Single Stem Treatment

This method is generally used on sites with fewer stems per acre. The herbicide is applied by directing the spray nozzle at the soil in the area where roots of the unwanted trees are growing. Typically, the equivalent of 2 to 4 mL of Velpar L concentrate per 1 inch d.b.h. is applied in evenly spaced soil spots around the tree.

Figure 12. – Applying herbicide using the hack-and-squirt method.

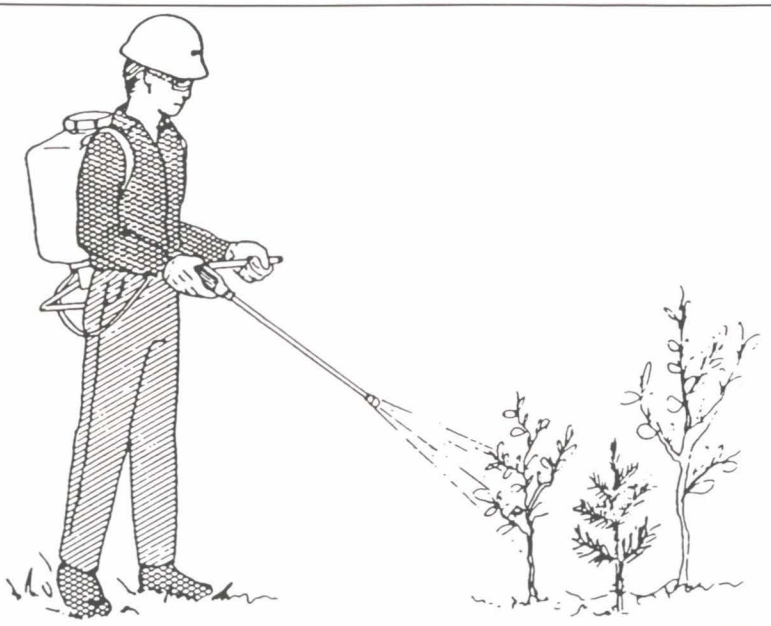


Figure 13. – Applying herbicide using the directed-spray method.

Figure 14. – Applying herbicide using the streamline method.

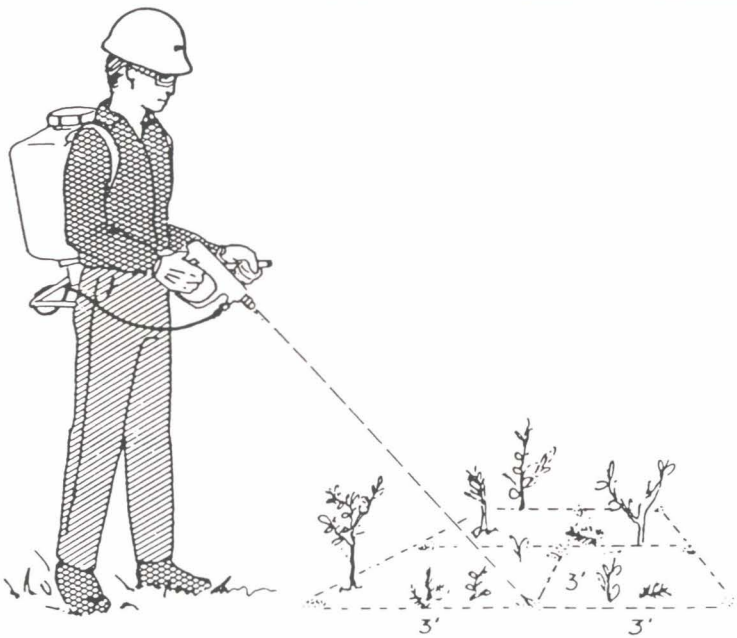


Figure 15. – Applying herbicide using the spot-grid method.

HARVEST CUTTING

The four methods of harvest cutting include: clear cutting, seed tree or shelterwood cutting, diameter limit cutting, and selection cutting. Harvest cutting should take place only when the stand is mature, badly highgraded, or so understocked or diseased that it offers no potential for continued management. Economic maturity for pine will vary depending on local markets, establishment costs, growth rates, landowner objectives, etc. Highest stumpage prices for pine in many areas are attained when the trees are 16 to 18 inches in diameter at breast height (d.b.h.).

Clear cutting removes all of the merchantable timber in one operation. This practice is highly desirable when used to regenerate overmature or badly understocked stands, to convert less desirable stands of off-site hardwoods (oak-hickory) to a highly desirable stand (pine), or whenever you are ready to regenerate intolerant species. Clearcutting has been given a bad name because some owners fail to provide for immediate regeneration of a new stand, and because of the temporary lack of beauty of the area. To ensure the practicality of clearcutting, immediate planting, or reseeding in the case of a pine stand, is required. Chopping may be used to liquidate unwanted saplings and advance reproduction of hardwood stands.

In **seed tree cutting,** the stand is clear cut, leaving a sufficient number of trees of the desirable species to cast seed over the entire area. The number of seed trees to be left depends upon their size, species, seed-bearing characteristics, and site conditions. More details are given in the *Regeneration* section.

The term **shelterwood** is often used. In the South, this term has become synonymous with a heavy seed tree cut in which 20 or more large trees are left. These trees may be removed in more than one cut. Among the southern pines only longleaf pine requires the shelterwood method because of its poor seeding habits.

Diameter-limit cutting was widely used in the past, but is no longer recommended. No marking was required. Instead, all trees of a certain stump diameter and larger were specified for removal. This system has fallen into disuse because it leads to highgrading the stand — removing the best and leaving the poorest trees.

The three previously mentioned systems produce even-aged stands. Many landowners have uneven-aged stands — better, all-sized stands — that are adapted to **selection cutting**. This method of cutting entails the removal of the mature timber either as single, scattered trees or in small groups at fairly short intervals. Successful selection cutting depends upon the ability of reproducing trees to become established and to survive in the openings left in the stand by the removal of the economically mature timber. Use single tree selection to thin the younger portions of the stand and to shape the stand structure. Use group selection — clear cutting patches of mature areas — to open up regeneration areas. The beauty of this system is that you can harvest some trees periodically and yet continue to have a well stocked forest at all times.

All trees to be cut should be marked with paint at breast height and at the ground line. Consider cutting all sizes of trees from 5 inches d.b.h. to the maximum size to be grown. Much of the marking will be done to thin the stand and release the better trees for further growth. The objective in marking should be to grow quality trees for sawlogs, veneer or plywood, and poles. In well-stocked stands on a good site, 25 to 30 percent of the volume can be removed periodically without depleting the growing stock.

INTERMEDIATE CULTURAL TREATMENTS FOR HARDWOODS

Hardwoods predominate on more than one half of the forests in the South. Where there is a pine seed source, it is generally more profitable to manage for pine. If the site is dry, convert it to pine by planting loblolly in the coastal areas, shortleaf in the cooler interior, and white pine in the cold, mountainous areas. Manage most of the moist sites for hardwoods. Such areas include the small stream and river bottoms, coves, and north- and east-facing slopes.

Intermediate cultural treatments for hardwoods include pre-commercial thinning, commercial thinning, release cutting, and improvement cutting. Present markets for small hardwoods are rarely good. The goal in hardwood management should be to produce high quality wood.

All of the intermediate cultural treatments should be aimed at stimulating the growth and maintaining the quality of the crop trees

— the best trees of the preferred species that will make up the final harvest cut. Favored species include the oaks, yellow-poplar, walnut, ash, sycamore, sweetgum, and several other, less prominent species for certain situations. These crop trees should occupy a dominant or co-dominant position in the stand, be straight and tall with relatively small branches, and show signs of self pruning on the butt 16 feet. To produce quality trees, fire must be kept out of the stand; any logging must avoid scarring of the crop trees. Thinning should not open up the stand so much that epicormic (sprout) branching is induced on the lower trunk. Precommercial thinning can be done to improve the growth and development of crop trees, but this cutting should be delayed until the crop trees can be identified as having dominant or co-dominant crowns within the stand. The stand will usually be 15 to 20 years old before this condition prevails.

In even-aged stands a commercial thinning for pulpwood (when markets are available) should be made when the crop trees average 8- to 10-inches in diameter. Remove mainly 6- to 8-inch trees that compete with the crop trees. Where pulpwood markets are lacking, cut the less desirable trees for fuelwood. Repeat thinnings may be made at 10-year intervals, but no cutting at all is usually better than the premature harvest of a large number of desirable 8-, 10-, 12-, and 14-inch trees, which would usually be replaced by less desirable trees.

Previous cutting may have left a stand with a wide range of diameters and with many low quality trees in it. In such instances, a commercial improvement cut may be made to remove over-mature, damaged, and dying trees of marketable size and quality if enough vigorous, desirable trees are left to adequately stock the stand. If necessary, a few high quality trees may be cut to attract buyers. Improvement cuts ultimately will mold a hardwood stand into even-aged groups of trees. Some species, chiefly cottonwood, willow, sweetgum, baldcypress, yellow-poplar, and the tupelos, usually occur in even-aged, almost pure stands.

Make the final harvest cut when the average crop tree is about 20 inches d.b.h. If there is no pressure to cut, you may wish to grow them to be 22- or 24-inches d.b.h. Every additional inch in such trees is extremely valuable. On poorer sites, your most profitable option may be to harvest the crop trees when they are only 16 inches d.b.h.

Selection of the type of harvest cut should be influenced by the regeneration requirements of the species in favor. Consider leaving some areas of large hardwoods for game food and shelter.

You would be wise to get professional advice on hardwood cultural treatments.

FOREST PROTECTION

FIRE

More than 70,000 wildfires and about 1 million acres burn each year in the South. Both nationally and in the South, incendiarism is the number one cause. Debris-burning fires that escape are another major cause. These fires account for about 20 percent of the wildfires in the South. They are one of the more preventable fire causes. In most cases, debris-burning fires are the result of carelessness. Use caution when burning debris! Contact your local forestry agency before burning.

Small surface fires kill seedlings and small trees, especially if the soil and litter are dry. Crown fires may wipe out a productive stand of large trees converting the area to a brush stand of inferior species. Even though a wildfire may not kill a tree, it may leave a fire scar where disease can enter if the intensity is hot enough to penetrate the bark, especially on hardwoods. Fire-weakened trees may also be attacked by insects or felled by the wind years after the fire.

Wildfire can impair the ability of watersheds to absorb rainfall and hold back runoff, fosters erosion, lessens the storage capability of the soil, and can reduce the water quality in adjacent streams and lakes because of sedimentation. Large, fast-spreading fires can kill animals trapped in the fire and destroy the nesting areas of birds.

Wildfires consume all of the litter, and repeated annual burns will damage the more palatable forage such as yellow indiangrass and the big and little bluestems, favoring less desirable species such as threeawns and lovegrasses. Uncontrolled wildfires reduce the quality of forage production. Wildfire can drastically reduce visibility and create locally hazardous conditions for aircraft and highway traffic.

Fire is a poor master but a good servant. In pine management, fire is a versatile and economical tool. However, fire is seldom prescribed for use in hardwoods. Prescribed burning done by trained specialists consumes less material, resulting in the release of less pollutant material than that created by a wildfire. Prescribed burning also reduces the potential damage from wildfire by controlling fuel buildup (dead branches, leaves, and other debris on the ground). Prescribed fire is useful in site preparation, and can control competing plants without disturbing the soil and humus layers. Fire controls brownspot and increases visibility for marking, logging, and hunting. Prescribed burning is an important management tool in improving wildlife habitat. When prescribed fire is used properly, it can improve the availability, quality, and palatability of forage, and controls undesirable species.

About 5 to 6 million acres are prescribed burned annually in the South on all ownerships. Prescribed burning requires skill and good judgment. Among the techniques that must be mastered to use fire as a tool are: selecting the best method of burning, timing the burn, selecting proper weather conditions, and managing the fire for smoke control to prevent off-site problems. Ask for assistance from experienced sources such as your State forestry agency.

Construct permanent firebreaks to divide pine stands into blocks no larger than 40 acres, and to separate areas to be managed for hardwoods from the pine type. Access roads may serve as firebreaks. Where young pine has been planted or seeded along a public road, you may need to maintain a plowed or disked fireline between the road and the pines until the stand can be fireproofed by a prescribed burn. Plowed lines should be carefully located and constructed to avoid erosion. Where incendiarism is a problem, a cooperative effort with one's neighbors can frequently eliminate the source.

INSECT AND DISEASE DAMAGE

Although many kinds of insects attack pines, only four groups cause major problems: reproduction weevils (figure 16), tip moths, sawflies, and bark beetles (southern pine beetle, pine engraver beetles, and the black turpentine beetle; see figure 17).

The odor of fresh pine resin attracts reproduction weevils to areas where pine is being cut. The weevils deposit their eggs in the

Figure 16. – Reproduction weevil.

Figure 17. – Bark beetles.

large roots of fresh pine stumps, where the larvae develop in the inner bark of the root. On emerging, the new adults feed on the tender bark of pine twigs or seedlings, frequently girdling them. Damage can be reduced by a 9-month delay in replanting pines on a cutover area, or by use of pesticides. An alternative is to spray the seedlings with Dursban 4E immediately after planting. Check before planting to see if these weevils are a problem in your area.

Tip moths prefer loblolly, shortleaf, Virginia pine, and occasionally attack slash pine, but do not harm longleaf or eastern white pine. Their attacks rarely have much effect on growth, and usually cease to be a problem after trees grow to about 10 to 15 feet, although sometimes tip moths are found on trees as high as 30 feet. Growth reduction is most serious on poor sites. A partial overstory reduces the incidence of attack. In some areas, you can reduce risks of attack by tip moths if you select a resistant tree species when planting.

Generally, the worst damage by sawflies is caused by those with multiple generations, which feed in the summer and fall on

both old and new needles. Attacked trees may suffer a loss in diameter growth, but usually recover within a year or two. Severe infestations in young plantations will stunt or malform trees, and repeated stripping sometimes kills the trees. Usually, sawfly infestations appear suddenly, continue for one or two seasons and abruptly disappear. Shortlived outbreaks seldom warrant chemical control. If defoliation occurs repeatedly, chemical control may be desirable using malathion, acephate, or carbaryl.

The southern pine bark beetles may multiply rapidly and cause widespread timber losses if conditions are favorable for their development. The most common factor associated with beetle outbreaks is poor tree vigor caused by drought, fire, lightning, flooding or careless logging. Thus, the best way to avoid timber losses from bark beetles is to maintain vigorous growth of the stand through stocking control and avoid damage to trees while logging. Control methods include rapid salvage and utilization, cut-and-leave, piling and burning infested material, or employing cut-and-spray practices using lindane, chlorpyrifos (Dursban 4E), or fenitrothion (Pestroy 8E).

Economically, the trunk borers are the most important destructive group of insects in hardwoods. Larvae of the carpenter worm and longhorn beetle attack the trees throughout their growth, and construct large galleries in the wood. Bark injuries at entrance holes become ingrown bark pockets in wood. Microorganisms stain and decay the wood along and adjacent to the galleries. This damage may be greatly expanded by carpenter ants that occupy vacated borer tunnels and hollow out larger cavities. Many smaller species of beetles add to the damage. Remove weak, cull trees that harbor both insects and disease to reduce the level of attack in nearby vigorous trees.

Defoliation by insects restricts tree growth and loss of seed occurs from destruction of tree flowers. For example, forest tent caterpillars defoliated coastal gum forests, limiting growth to about one-fourth the potential for the year, and prevented seed production. Ultra-low-volume spraying of gum forests and cottonwood plantations with selected insecticides has demonstrated effective control of insects without damage to associated wildlife.

Among the most effective defenses against disease are matching species and management practices to site, to maintain healthy,

vigorous stands. For example, damage from root rot (figure 18) caused by the fungus *Heterobasidium annosum*, is related to site. Soils with 12 inches or more of sand in the top horizon are considered high-hazard sites as are old-field sites. Avoid heavy losses on high-hazard sites by planting more resistant species such as longleaf pine rather than the more susceptible loblolly or slash pines. On high-hazard sites, close spacing favors rapid spread of the disease after the first thinning. Delay this thinning as long as possible and make it in the summer, when few fungus spores are present. In the summer, stump temperatures during the day are usually hot enough to prevent spore germination. Apply powdered borax to cut surfaces of stumps immediately after felling on high-hazard sites during cooler season. Use *Phlebia gigantia* to increase stump decomposition and reduce *annosum* incidence.

Fusiform rust (figure 19) is a major disease of loblolly and slash pine, but longleaf and shortleaf pine are immune. Close spacing induces early natural pruning, thus preventing branch galls from reaching the trunk. (Avoid close spacing on annosus-prone sites.) Remove infested trees in thinning operations to salvage trees that are starting to die. You may not need to cut all diseased trees. Allow trees heavily infested with fusiform rust to grow for up to 8 more years if less than 50 percent of the trunk circumference is killed (cankered). Disease-resistant strains of pine are being developed.

Figure 18. – Root rot.

Figure 19. – Fusiform rust.

Littleleaf disease of pine, particularly of shortleaf, is caused by a complex of factors involving the soil fungus *Phytophthora cinnamoni*, and other adverse factors such as poor aeration, low fertility, and periodic moisture stress. Severe littleleaf sites have thin topsoil (the result of past sheet erosion) underlain by heavy, plastic, poorly drained subsoil. Littleleaf does not spread from tree to tree, but develops where site conditions favor its growth. Select loblolly and other more resistant pines instead of shortleaf pine on littleleaf-prone sites.

Longleaf pine, which is quite resistant to fusiform rust and southern pine beetle attack, is highly susceptible to brown spot needle blight. Strains of longleaf that are highly resistant to brown spot have been identified and are being grown in seed orchards. Until resistant seedlings are available, judicious use of fire, or benomyl root treatment will help to control brown spot and to stimulate early height growth.

Fire prevention is important in reducing losses to disease in hardwoods. Trunk rot and canker fungi can destroy much of the valuable butt log following fire injuries. Other diseases enter through broken tops and branch stubs. Careful logging will reduce the number of wounds through which fungi enter standing trees.

MANAGING FOR MULTIPLE USE

WILDLIFE HABITAT IMPROVEMENT

Increasing the production of wildlife on forest land depends on increasing the availability of food and cover. Where timber markets exist, you can improve the habitats of some species by good management practices. Many wildlife species thrive along the edges of openings in the forest. They need a mixture of forest tree species and conditions. Thinnings should be early and heavy to favor mast-producing trees and to open up the understory. Leave den trees for squirrels. Pine stands should be prescribed burned every 2 years for quail, and every 3 to 5 years for deer and turkey. It is important to identify the wildlife species you prefer, in your management plan, so management activities can be targeted to enhance the habitat.

Squirrels

Hardwoods are a must for gray squirrels. They require partial hardwood stands of trees old enough (25 years) to produce mast and provide dens (40 years). The squirrels' home range is 2 to 8 acres. Reproduction is 2½ times more successful in tree cavities than nests. Den entrance holes are usually 2½ to 3 inches in diameter; den cavities 14 inches deep. They should be waterproof and 15 feet or more above ground level. A squirrel needs about 1½ pounds of hard mast per week from September through March. Preferred foods are hickory nuts, beechnuts, white oak group and black (or red) oak group acorns, in that order. Supportive foods are berries, soft mast, buds, seeds, and fungi. Red maple is a particularly important source of food in early spring and mulberry in May and June. See table 3.

Quail

The best habitats for quail include interspersed open forests, brush, grass and cultivated fields, but the birds survive in many forest types. Choice nesting cover is 1-year-old-grass. They also nest at the edges of forest clearings. Each nesting pair should have

Table 3. — Typical seasonable foods of gray squirrels.

August-October	*November-January*	*February-April*	*May-July*
Hickory and pecan	Hickory	Acorns	Buds and flowers
Beech	Beech	(black oak group)[1]	Berries
Blackgum	Walnut	Hickory	Mulberry
Acorns	Acorns	Beech	Mushrooms
(white oak group)[1]	(white oak group)[1]	Buds and flowers	Blackberry
Acorns	Acorns	of maple, elm,	Yellow-poplar
(black oak group)[1]	(black oak group)[1]	oak, etc.	
Sugar maple seeds	Blackgum	Mushrooms	
Pine seeds	Yellow-poplar	Red maple seeds	
Walnut		Magnolia	
Mushrooms		Cucumber	
Dogwood			
Hawthorn			
Hornbeam			
Chinquapin			
Yellow-poplar			
Black cherry			
Grape			

[1]The black (or red) oaks are characterized by bristles on the tips of leaf lobes; acorns mature at end of the second season. White oak acorns mature at the end of the first growing season; leaf lobes are not bristle-tipped.

access to clearings 1/5 acre or larger. Normal range is 40 acres. Quails nest from April to September. Seeds make up 85 percent of the quail diet. Legume, grass, and weed seeds are the most important foods, in that order. See table 4.

Deer

Deer live in most forest and non-forest conditions and types. Their home range seldom exceeds 300 acres where food, cover and water are interspersed. Prescribed burning and fertilization attract deer because of the improved nutrition and palatability of food plants. The early stages of timber rotation and intermediate cuts produce abundant deer browse and fruits. During the fall and winter, deer prefer hard mast (acorns, pecans, beechnuts) and evergreen forage. Rapid-growing green browse and herbage are principal spring and summer foods. Deer require about 6 to 8 pounds in green weight of food daily for each 100 pounds of animal weight. See table 5.

Table 4. – Important quail foods of the Piedmont and Coastal Plains forests, together with plant part utilized.

Herbaceous Plants		*Trees, Shrubs, and Vines*	
Ragweed	Seed	Maple	Seed
Beggarticks	Seed	Hackberry	Seed
Partridge pea	Seed	Flowering dogwood	Seed
Goatweed	Seed	Persimmon	Seed
Chufa, nutgrass	Tubers	Bayberry	Seed
Tick trefoil (beggarweed)	Seed	Blackgum	Seed
Wild millet	Seed	Pines, longleaf,	
Lespedeza	Seed	loblolly (preferred)	Seed
Grasses	Seed	Cherry	Seed
Pokeweed	Berry	Oaks	Seed
Smartweed	Seed	Sumacs	Seed
Vetch	Seed	Blackberry	Berry
Panicum	Seed	Grapes	Berry
Milk peas	Seed	Magnolia, bay	Seed
Butterfly peas	Seed	Sweetgum	Seed

Table 5. – Major sources of food for deer, in order of preference, in each of three areas.

Mountains	*Piedmont*	*Coastal Plain*
Greenbriar	Japanese honeysuckle	Black titi
Azalea	Greenbriar	Tall gallberry
Blueberry	Yellow-poplar	Greenbriar
Chestnut	Azalea	Honeysuckle
Dogwood	Viburnums	Blackberry
Blackgum	Sourwood	Yellow jessamine
Oak	Blackgum	Myrtle holly
Sourwood	Dogwood	Wild rose
Mountain laurel	Soft maple	Deer's tongue
Huckleberry	Blueberry	Mushrooms
Strawberry-bush	Cherry	Sumac
Buffalo nut	Persimmon	Prickly pear
Japanese honeysuckle	Blackberry	Yaupon
Blackberry	Strawberry-bush	Sassafras
Sumac		Viburnums
Hydrangea		Strawberry-bush
Aralia		
Grape		
Rhododendron		

Turkeys

Good turkey habitats contain mature stands of mixed hardwoods, groups of conifers, relatively open understories, and scattered clearings, well distributed over the area. Openings are essential for raising young turkeys. A home range is about 1 square mile. Turkey diets consist mainly of grass and weed seeds in the fall, mast and forage in winter and spring, and forage and insects in the summer. Acorns, dogwood berries, clover and pine seed are the foremost foods. Soybeans, corn, and pasture are the farm crops most often used. See table 6.

Table 6. – Food of wild turkeys.

Grass and weed seeds	Other tree seeds
Paspalums (bullgrasses)	Sweetgum
Panicums	Pine
Native legumes	
	Insects and snails
Hard mast	Grasshoppers
Acorns	Millipedes
Beechnuts	Insect larvae
Pecans	
	Berries
Forage	Blackberries and dewberries
Clovers	Huckleberries
Grasses	Strawberries
Sedges	
	Grain
Soft mast	Oats
Dogwood	Corn
Grapes	
Cherries	

Nongame Birds

Just as diversity is the spice of life so are diversity of tree species, age of stand, and stand density the key elements in providing woodland habitats favorable to nongame birds. Some birds are found mainly in the forest interior, some in forest edges and areas with scattered trees, and some are found in both of these areas. Some forest management practices decrease the complexity of the forest while others increase it. Practices that can destroy the understory appear to be harmful to some nongame birds. Examples include intensive site preparation, annual burning, removal of dead trees and snags, as well as measures to promote monoculture (such as intensive hardwood control in pine stands.)

Several strategies can be used to increase nongame bird numbers and species. The following examples of some of these strategies are not intended to be used all together on the same tract:

- Manage for a mixture of pine and hardwood (not necessarily in the same stand but in adjacent stands).
- Maintain some stands of 80 years or more in age to provide suitable cavities for nesting and the production of high energy fruits and mast.
- Make long, narrow clearcuts with undulating edges.
- Foster low thickets of brush and vines, and piles of brush or tree tops for nest sites.
- Plant pine at wide spacings, with subsequent heavy thinning.
- Regenerate forest stands by natural methods.
- Practice uneven-aged management, with group selection.
- Use prescribed burns infrequently.
- Leave snags and hardwoods with cavities.

CATTLE GRAZING

Some forest conditions provide opportunities for livestock grazing. Young or mature age classes of southern pine forests usually contain the best opportunities. Forest forage conditions are important, along with associated conditions of pasture, fencing, clean water supply, livestock handling facilities and soil moisture/temperature conditions. Coordinated management of timber and livestock practices is a must for a successful operation. Shading by hardwoods under pine stands should be controlled to allow maximum sunlight on the forest floor for best forage production. Forest forage declines in nutrient and energy values in the fall through winter. Pasture

management systems are important to capture spring growth before seed ripens or after one of these peaks, not both. Timber stands designated for multipurpose use should have trees at least 10 feet tall to avoid poor stocking and excessive damage.

Prescribed fire is a useful tool to improve the availability, desirability and short term nutrient quality of native forage for livestock in pine stands. Fire will reduce needle and leaf accumulations and competition from hardwood brush. However, this exposes more ground to the serious problem of soil compaction, which reduces timber volume growth by about 50 percent. Native grasses of southern pine forests usually tolerate cool, prescribed burns.

WATERSHED MANAGEMENT IN THE FOREST

The key to maintaining good forest watershed conditions lies in proper management of the forest floor. Even when disturbed, accumulating forest litter effectively reduces soil movement and excessive surface runoff within 3 to 5 years on most sites. With time, more water will soak into the soil as organic matter blends into the surface soil. Of course, the forest floor must be protected from additional disturbances to accomplish these improvements.

Timber harvesting at periodic intervals, using systems compatible with site-special soil, slope and stream characteristics, permits timber production and watershed protection to continue in harmony. Logging truck roads and skid trails are among the leading contributors to watershed deterioration. Skidding can seriously compact the soils when skid trails are not designated and "loggers choice" skidding system is allowed.

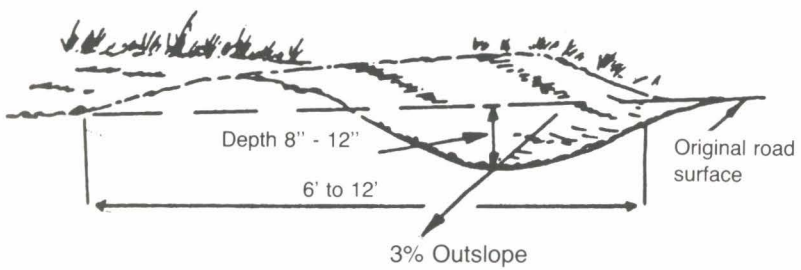
Advance planning of the logging operation can prevent much of this erosion by confining the roads to the ridge tops. Roads should be located just to one side of the ridge line to improve drainage. When roads traverse the hillside, they follow the contour, roll with the grade to avoid excessive cut and fill slopes. Road grades of 3 to 5 percent are desirable; however, sustained grades of 6 to 8 percent are acceptable when following Best Management Practices. An occasional short pitch of up to 15 percent can be tolerated if proper road drainage is built into the road, to avoid unacceptable erosion. Use dips frequently to break long grades and

construct cross-drains as needed and outslope road beds. See figure 20 and table 7. Locate the roads far enough from water courses to provide an effective forested filter strip. Keep trucks, tractors, skidders, and logs away from drainage channels. When logging is over, "put roads to sleep," i.e., smooth out ruts and holes to prevent channeling runoff, install cross drains and clean culverts (if used), cultivate or rip and seed the abandoned roads with a grass/legume seed mixture, including some preferred by wildlife species.

Skidding should be uphill on designated skid trails. Winching logs to this trail will minimize the number of skid trails, lower restoration costs and restrict land area that will be subject to reduced growth potential. Along intermittent drainage and stream channels, maintain undisturbed strips of forest floor 25 feet wide, plus an additional 2 feet for each 1-percent increase in slope. These strips will filter out sediment, preventing it from entering the channel.

Runoff water from the public road system is often a major contributor of sediment and stormflow from forested watersheds. Inside road ditch maintenance should be done carefully so as not to dig out rooted vegetation or dispose of it improperly.

Roadway and culvert drainage should be dispersed and slowed to retard runoff and encourage vegetation/forest floor filtering. Stabilize the streambank or channel by planting trees and fostering a vigorous, healthy timber stand. Follow forestry Best Management Practices. It saves time, money and energy.



Source: *Loggers' Guide to Forestry*, Tennessee Division of Forestry.

Figure 20. — Water bar installed at angle to divert runoff into vegetated areas that filter sediment.

Table 7. — Recommended distance between water bars on skid roads and truck roads which have been "put to sleep".[1]

Grade of road	Distance between water bars
percent	*feet*
2	250
5	135
10	80
15	60
20	45
25	40
30	35
40	30

[1]With the skid roads protected and "put to sleep," little attention will need to be given to them during the ensuing years. And, when the time comes to remove another crop of timber from the area, the protected logging road will result in lower operating costs and correspondingly higher timber prices to the landowner. (This table is reproduced from table 3 in *Permanent Logging Roads for Better Woodlot Management*, by Richard F. Haussman and Emerson W. Pruett.)

RECREATIONAL OPPORTUNITIES

The family forest provides space, shade, clean air, cool nights, probably a stream or a pond, fishing, hunting in season, but most of all an opportunity to get away from the pressures and tensions of daily life. The forest provides a place to pick berries, gather nuts, observe wildflowers and wildlife, study nature and become involved in wholesome outdoor projects such as woodcutting. The natural beauty of a family forest is enhanced to the owner by the care taken to preverve and improve favorite scenic areas.

Forest management practices such as timber harvests often provide a means to help owners enjoy their forests. Logging roads and skid trails often require little additional effort to maintain for walking trails or wildlife observation paths. Timber harvests can also open vistas so attractive forest or rural settings can be seen. Wildflowers, rare in the dense forests, often flourish in openings prepared for tree planting.

Hiking, horseback riding, and trailbike riding can be done over a network of rough forest roads developed for logging access, or fire breaks. Such roads should be at least 10, but preferably 15, feet wide, with leadoff ditches and water bars where erosion hazards exist. To be effective as a firebreak, seed the road to grasses or legumes that remain green and relatively nonflammable during the winter forest fire months (October 15 to May 15). Kentucky fescue, a perennial grass, provides good winter cover and can be grown in combination with white clover or winter peas. Rye grass, an annual, will quickly protect the soil. Common bermuda grass is widely used in some areas. These forest roads should be fertilized and limed every 3 or 4 years to maintain a good cover.

Aesthetics will govern how many owners manage their land. Species such as blackgum, dogwood, fringetree, magnolia, mountain laurel, redbud, some red maple, rhododendron, sourwood, sweetgum and yellow-poplar can be reserved along the roads and trails for their flowering habit or colorful foliage. Some owners may even wish to release these species from the competition of other trees.

ECONOMICS

FINANCIAL CONSIDERATIONS

Because timber production requires a long term investment, many people may not be able to readily evaluate the financial opportunity from timber or to compare it with other investments. Time and interest rates play an important part in an evaluation of the financial alternatives.

What interest rate should one use to evaluate forestry investment? The rate should be at least as high as safe investments such as U.S. Treasury bonds and notes. Generally, one should expect more from forestry investments than from other safe investments mentioned above because of the length of time required for a return on the investment. The interest rate should also reflect the risk factors incurred in forestry investments.

Four investment terms are often used in evaluating return on investments for timber production. A brief description of the value and differences among these investment terms follows:

Present Net Worth (PNW) is the difference between the present value of all costs (present and future) and income at a given interest rate. A positive PNW indicates that the investment furnishes a higher return than the selected interest rate. A PNW of zero indicates an investment that equals the selected rate. The selected interest rate usually indicates the investor's minimum objective or alternative investment opportunity.

Annual Equivalent Value (AEV) is the amount of annual income or payment that will just equal the present net worth of an investment during its lifetime. In forestry, the AEV is theoretical because income does not occur on an annual basis. However, AEV figures are useful in comparing forestry investments with investments that have an annual return.

Rate of Return is sometimes called the internal rate of return. The rate of return is the compound interest rate used where the present net worth is zero. In other words, the rate of return is the compound interest rate that equates the present value of all future incomes with the present value of all future costs. All incomes are assumed to be reinvested at the same rate of return.

Cash flow is simply the time and amount of cost and returns. A cash flow diagram is a simple way to show the timing of cost and revenue. The cash flow diagram for a pine plantation costing $50 per acre to establish, and yielding returns of $65 per acre at age 16, and a return of $900 per acre at year 25 would be:

Time (year):	0	5	10	15	16	20	25
	1	1	1	1	1	1	1
	1	1	1	1	1	1	1
Net cash flow:	−50				+65		+900

Cash flow is not a true measure of the return on an investment because the effect of time and interest rates on the purchasing power of the dollar are not considered.

Following is a sample of an investment analysis that is typical of the rate of return on a loblolly pine plantation having a site index of 70, and an annual cost of $1 per acre per year. This example assumes a 28-year rotation:

Rate of return on a loblolly pine plantation

Selling price for pulpwood	Establishment costs ($)					
	10	20	30	40	50	60
	- - - - - - *rate of return (percent)* - - - - - -					
5	12.9	10.4	8.9	7.8	6.9	6.2
9	15.4	12.7	11.1	9.9	9.0	8.2
12	17.2	14.4	12.7	11.4	10.5	9.7
15	18.7	15.7	13.9	12.6	11.6	10.8
18	19.9	16.8	14.9	13.6	12.6	11.8

The preceding table shows that if your establishment cost for your plantation is $50 per acre, and you receive $15 per cord, your rate of return on the investment will be 11.6 percent.

TAX CONSIDERATIONS

Family forest managers should be aware of a number of tax benefits. Considerable financial returns can be realized by forest managers who take full advantage of the tax provisions for forestry investments. Remember, proper tax planning is every bit as important as the silvicultural techniques employed to grow a timber crop. Hence, you should plan well ahead on how you are going to handle your taxes. Forest taxation is too complex a subject to be fully discussed here, but the following summary of tax considerations should help guide your plan.

Recordkeeping

Keep accurate records of all transactions. Bookkeeping need not be complicated. What is needed is an orderly list of original costs and expenditures as they are made, backed up by appropriate documents. Where significant sums of money are involved, such as

timber sales and reforestation activities, it is good business to hire a competent tax preparer such as a CPA or consultant forester who specializes in forest taxation. Remember, plan ahead!

Capital Gains

When you harvest your timber, you can get a significant tax advantage if you report your gain as a capital gain. If you report your gain as ordinary income, it may likely be subject to the additional, and substantial, self-employment tax. Be sure to consult a tax specialist before you sell your timber so you can dispose of your timber under the appropriate contract method to get the best tax advantage.

Reforestation Tax Incentives

Reforestation activities qualify for special tax considerations. These activities serve as an incentive for family forest managers to reinvest revenue from timber sales back into reforesting their cutover lands. This reforestation incentive provides a 10-percent reforestation tax credit plus a 7-year amortization of the first $10,000 of reforestation expenses each year. What this means is that your reforestation costs, up to $10,000 a year, can be recovered in 7 years instead of having to wait until you have a timber sale to recover your expenses.

Casualty Losses

Casualty losses sometimes occur on the family forest. A casualty is defined as the complete or partial destruction of property resulting from an identifiable event of a sudden, and unexpected or unusual nature. Some examples are hail and ice storms, hurricanes, forest fires, and floods. Death of trees from insect or disease attacks generally do not quality as a casualty loss on business property, but may qualify on residential property. To deduct a casualty loss, proof of the casualty is necessary as well as proof that your loss occurred directly as result of the casualty. Take photos and save newspaper clippings as proof of casualty. Keep sales receipts, contracts, appraisal documents, or other verification of your prop-

erty's value. A claim for casualty losses can be no more than the owner's adjusted basis in the timber. This is the total investment minus those revenues previously recovered through timber sales or other casualty deductions.

Cost-Share Programs

Nonindustrial private landowners who qualify can participate in Federal and State programs that cost-share for certain reforestation and timber stand improvement practices. Check with the local offices of the Agricultural Stabilization and Conservation Service and the field forester representing your State forestry agency for information on available programs.

Finally, remember that tax laws change frequently. Be sure to check with a tax expert for the latest developments.

MARKETING THE FOREST CROP

Management plans and marketing require that you know the number of board feet that can be sawn from a tree or the volume of pulpwood in a tree. Board-foot tables for the standing trees with diameters at breast height (4½ feet above the ground) and the merchantable height are given in tables 8 through 13. Use tables 9, 11, and 13 for trees with little taper (Form Class 80) in the butt log. Use tables 8, 10, and 12 for most hardwoods and pines with substantial taper (Form Class 75). These tables give estimates of the gross volume.

Table 8. — Gross volume of tree, form class 75[1], International ¼-inch rule[2]

Tree diameter (inches)	VOLUME (board feet) BY NUMBER OF USABLE 16-FOOT LOGS										
	1	1½	2	2½	3	3½	4	4½	5	5½	6
10	33	43	53								
11	42	55	68								
12	51	67	83	95	107						
13	62	82	102	117	132						
14	72	96	120	138	157	169	181				
15	84	113	142	164	187	203	219				
16	97	130	163	190	217	237	257				
17	111	150	188	220	252	275	298				
18	125	169	213	250	286	312	339				
19	141	192	242	284	326	356	386				
20	157	214	271	318	365	399	433	460	488		
21	175	239	303	356	410	449	488	521	554		
22	193	264	335	394	454	499	544	582	620		
23	212	291	370	437	504	553	602	647	692		
24	232	318	405	479	553	606	659	712	764		
25	254	349	444	525	606	666	727	786	844		
26	275	379	483	572	660	728	795	860	924		
27	298	412	525	622	720	793	866	938	1, 010		
28	321	444	567	673	779	858	938	1, 016	1, 095	1, 164	1, 234
29	346	479	612	727	842	928	1, 014	1, 102	1, 189	1, 270	1, 352
30	371	514	658	782	905	998	1, 090	1, 186	1, 283	1, 276	1, 469

[1]Form class is the ratio between the diameter inside bark at 17 feet and diameter outside bark at 4.5 feet.

[2]Source: *Tables for Estimating Board-foot Volume of Timber*, by Clement Mesavage and James W. Girard.

Deductions must be made for defects in the bole of the tree caused by rot, cracks, worm holes, poor shape and crook, or sweep. In defect-free trees, such as most pines, the lumber cut from trees scaled by the International ¼-inch rule will tally out very close to the original estimates. Less precise estimates are given under the Doyle rule; a sawmill will cut out much more lumber from your logs than is measured by this scale, particularly from small trees and small logs. The Scribner rule is intermediate between the other two rules. Carefully consider the differences in these rules because the Doyle rule is widely used throughout the South. Be sure you know which scale prospective buyers are using for volume estimates.

Table 9. — Gross volume of tree, form class 80[1], International ¼-inch rule[2]

Tree diameter (inches)	VOLUME (board feet) BY NUMBER OF USABLE 16-FOOT LOGS										
	1	1½	2	2½	3	3½	4	4½	5	5½	6
10	39	51	63	72	80	-----	-----	-----	-----	-----	-----
11	49	64	80	92	104	-----	-----	-----	-----	-----	-----
12	59	78	98	112	127	136	146	-----	-----	-----	-----
13	71	96	120	138	156	168	181	-----	-----	-----	-----
14	83	112	141	164	186	201	216	-----	-----	-----	-----
15	98	132	166	194	221	240	260	-----	-----	-----	-----
16	112	151	190	223	256	280	305	-----	-----	-----	-----
17	128	174	219	258	296	325	354	-----	-----	-----	-----
18	144	196	248	292	336	369	402	-----	-----	-----	-----
19	162	222	281	332	382	420	457	-----	-----	-----	-----
20	181	248	314	370	427	470	512	546	580	-----	-----
21	201	276	350	414	478	526	575	616	656	-----	-----
22	221	304	387	458	528	583	638	685	732	-----	-----
23	244	336	428	507	586	646	706	761	816	-----	-----
24	266	368	469	556	644	708	773	836	899	-----	-----
25	290	402	514	610	706	779	852	922	992	-----	-----
26	315	436	558	662	767	849	931	1, 008	1, 086	-----	-----
27	341	474	606	721	836	925	1, 014	1, 100	1, 185	-----	-----
28	367	510	654	779	904	1, 000	1, 096	1, 190	1, 284	1, 368	1, 453
29	396	551	706	842	977	1, 080	1, 184	1, 289	1, 394	1, 491	1, 588
30	424	591	758	904	1, 050	1, 161	1, 272	1, 388	1, 503	1, 613	1, 723

[1]See footnote 1 in table 8.

[2]Source: See footnote 2 in table 8.

Table 10. — Gross volume of tree, form class 75[1], Doyle log rule[2]

Tree diameter (inches)	VOLUME (board feet) BY NUMBER OF USABLE 16-FOOT LOGS										
	1	1½	2	2½	3	3½	4	4½	5	5½	6
10	12	14	16	-----	-----	-----	-----	-----	-----	-----	-----
11	18	22	26	-----	-----	-----	-----	-----	-----	-----	-----
12	25	31	37	40	44	-----	-----	-----	-----	-----	-----
13	34	42	51	56	62	-----	-----	-----	-----	-----	-----
14	42	54	65	72	80	84	87	-----	-----	-----	-----
15	53	68	83	94	104	110	117	-----	-----	-----	-----
16	64	82	101	115	129	138	147	-----	-----	-----	-----
17	77	100	124	142	159	170	182	-----	-----	-----	-----
18	90	118	146	168	189	203	217	-----	-----	-----	-----
19	106	140	173	200	226	243	260	-----	-----	-----	-----
20	121	160	200	231	262	282	303	319	335	-----	-----
21	138	184	231	268	304	329	354	374	395	-----	-----
22	156	209	262	304	346	376	406	430	455	-----	-----
23	176	237	298	347	396	429	462	493	524	-----	-----
24	196	264	333	389	445	481	517	554	592	-----	-----
25	218	295	372	436	499	542	586	628	670	-----	-----
26	240	326	412	482	553	604	654	702	749	-----	-----
27	264	360	456	535	614	670	726	781	836	-----	-----
28	289	394	499	588	676	738	799	862	924	980	1, 036
29	316	432	547	644	742	810	878	949	1, 020	1, 087	1, 154
30	342	468	595	701	807	882	956	1, 036	1, 117	1, 195	1, 273

[1]See footnote 1 in table 8.

[2]Source: See footnote 2 in table 8.

Table 11. — Gross volume of tree, form class 80[1], Doyle log rule[2]

Tree diameter (inches)	VOLUME (board feet) BY NUMBER OF USABLE 16-FOOT LOGS										
	1	1½	2	2½	3	3½	4	4½	5	5½	6
10	16	20	23	24	26	-----	-----	-----	-----	-----	-----
11	24	30	35	38	42	-----	-----	-----	-----	-----	-----
12	31	39	47	52	57	60	62	-----	-----	-----	-----
13	42	53	64	72	80	84	88	-----	-----	-----	-----
14	52	67	82	93	104	109	114	-----	-----	-----	-----
15	64	84	104	118	132	141	150	-----	-----	-----	-----
16	77	101	125	143	161	174	186	-----	-----	-----	-----
17	92	122	152	175	198	214	230	-----	-----	-----	-----
18	108	144	179	206	234	254	273	-----	-----	-----	-----
19	126	168	210	244	278	301	324	-----	-----	-----	-----
20	144	193	242	282	321	348	374	396	417	-----	-----
21	164	221	278	324	370	403	436	462	489	-----	-----
22	185	250	315	368	420	458	497	529	561	-----	-----
23	208	282	356	417	478	521	564	604	643	-----	-----
24	231	314	397	466	536	583	630	678	725	-----	-----
25	256	350	443	522	600	655	710	764	818	-----	-----
26	282	386	489	576	663	727	791	852	912	-----	-----
27	310	425	540	638	735	806	877	946	1, 015	-----	-----
28	339	466	592	700	807	885	963	1, 040	1, 118	1, 188	1, 258
29	370	509	648	766	884	970	1, 056	1, 144	1, 232	1. 315	1, 398
30	400	552	703	832	961	1, 055	1, 149	1, 248	1, 346	1, 442	1, 537

[1]See footnote 1 in table 8.

[2]Source: See footnote 2 in table 8.

Table 12. — Gross volume of tree, form class 75[1], Scribner log rule[2]

Tree diameter (inches)	VOLUME (board feet) BY NUMBER OF USABLE 16-FOOT LOGS										
	1	1½	2	2½	3	3½	4	4½	5	5½	6
10	25	32	38	-----	-----	-----	-----	-----	-----	-----	-----
11	34	43	52	-----	-----	-----	-----	-----	-----	-----	-----
12	42	54	66	74	83	-----	-----	-----	-----	-----	-----
13	52	68	84	96	107	-----	-----	-----	-----	-----	-----
14	63	82	102	116	131	140	148	-----	-----	-----	-----
15	74	98	122	141	160	172	184	-----	-----	-----	-----
16	86	114	142	165	188	204	220	-----	-----	-----	-----
17	100	133	166	193	220	240	260	-----	-----	-----	-----
18	113	152	191	222	253	276	299	-----	-----	-----	-----
19	128	173	218	255	292	318	344	-----	-----	-----	-----
20	144	195	246	288	331	360	389	412	435	-----	-----
21	160	218	276	324	372	406	441	470	498	-----	-----
22	177	242	306	360	413	453	493	526	560	-----	-----
23	196	268	340	401	462	505	548	588	629	-----	-----
24	216	296	375	442	510	556	603	650	698	-----	-----
25	236	324	412	486	560	615	670	722	774	-----	-----
26	257	352	448	530	611	674	736	794	851	-----	-----
27	280	385	490	580	669	736	804	869	934	-----	-----
28	302	416	531	629	727	800	872	944	1, 017	1, 080	1, 144
29	326	451	576	682	789	868	946	1, 027	1, 108	1, 183	1, 258
30	351	486	620	736	851	936	1, 021	1, 110	1, 199	1, 286	1, 373

[1]See footnote 1 in table 8.

[2]Source: See footnote 2 in table 8.

Table 13. — Gross volume of tree, form class 80[1], Scribner log rule[2]

Tree diameter (inches)	VOLUME (board feet) BY NUMBER OF USABLE 16-FOOT LOGS										
	1	1½	2	2½	3	3½	4	4½	5	5½	6
10	30	38	47	52	57	-----	-----	-----	-----	-----	-----
11	40	52	64	72	80	-----	-----	-----	-----	-----	-----
12	50	65	80	91	102	108	115	-----	-----	-----	-----
13	62	82	101	116	130	139	148	-----	-----	-----	-----
14	74	98	122	140	158	170	181	-----	-----	-----	-----
15	88	117	146	169	192	208	223	-----	-----	-----	-----
16	101	136	170	198	226	246	265	-----	-----	-----	-----
17	116	156	197	230	264	288	312	-----	-----	-----	-----
18	131	178	224	263	302	330	359	-----	-----	-----	-----
19	148	202	256	300	345	378	411	-----	-----	-----	-----
20	166	226	287	338	388	426	463	492	522	-----	-----
21	185	254	322	379	436	480	523	558	594	-----	-----
22	204	280	357	420	484	534	583	624	666	-----	-----
23	226	311	396	468	540	594	648	697	746	-----	-----
24	248	342	435	515	595	654	712	770	827	-----	-----
25	272	376	479	568	656	722	788	852	917	-----	-----
26	296	410	523	620	716	790	865	936	1, 007	-----	-----
27	322	446	570	677	784	865	946	1, 025	1, 104	-----	-----
28	348	482	617	734	851	940	1, 028	1, 114	1, 200	1, 278	1, 357
29	376	522	667	794	921	1, 017	1, 113	1, 210	1, 306	1, 396	1, 487
30	403	560	717	854	991	1, 094	1, 198	1, 306	1, 413	1, 515	1, 617

[1]See footnote 1 in table 8.

[2]Source: See footnote 2 in table 8.

The contents of 16-foot logs, in board feet, are given for the three rules in tables 14, 15, and 16. These tables are based upon the average diameter in inches inside the bark at the small end of the log. Note that the three rules give about the same scale only for the very largest logs — sizes which are no longer common.

Table 14. — Scale of 16-foot logs to nearest board foot[1] from International ¼-inch rule, ¼-inch kerf[2]

D.i.b. (inches)	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
6	19	20	21	22	23	23	24	25	26	27
7	28	29	30	31	32	33	34	35	36	38
8	39	40	41	42	43	45	46	47	48	50
9	51	52	54	55	56	58	59	60	62	63
10	65	66	68	69	71	72	74	75	77	78
11	80	82	83	85	87	88	90	92	93	95
12	97	99	100	102	104	106	108	110	112	114
13	115	117	119	121	123	125	127	129	131	133
14	136	138	140	142	144	146	148	151	153	155
15	157	160	162	164	166	169	171	173	176	178
16	181	183	185	188	190	193	195	198	200	203
17	205	208	211	213	216	219	221	224	227	229
18	232	235	237	240	243	246	249	251	254	257
19	260	263	266	269	272	275	278	281	284	287
20	290	293	296	299	302	305	308	311	315	318
21	321	324	327	331	334	337	341	344	347	351
22	354	357	361	364	367	371	374	378	381	385
23	388	392	395	399	403	406	410	413	417	421
24	424	428	432	435	439	443	447	451	454	458
25	462	466	470	474	478	481	485	489	493	497
26	501	505	509	513	517	521	526	530	534	538
27	542	546	550	555	559	563	567	572	576	580
28	584	589	593	598	602	606	611	615	620	624
29	628	633	637	642	647	651	656	660	665	669
30	674	679	683	688	693	697	702	707	712	716
31	721	726	731	736	741	745	750	755	760	765
32	770	775	780	785	790	795	800	805	810	815
33	820	826	831	836	841	846	851	857	862	867
34	872	878	883	888	894	899	904	910	915	921
35	926	931	937	942	948	953	959	964	970	976

[1]Computed from the formula V = 0.796 D - 1.375D - 1.230.

[2]Source: See footnote 2 in table 8.

Table 15. — Scale of 16-foot logs to nearest board foot[1] from Doyle rule[2]

D.i.b. (inches)	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
5	1	1	1	2	2	2	3	3	3	4
6	4	4	5	5	6	6	7	7	8	8
7	9	10	10	11	12	12	13	14	14	15
8	16	17	18	18	19	20	21	22	23	24
9	25	26	27	28	29	30	31	32	34	35
10	36	37	38	40	41	42	44	45	46	48
11	49	50	52	53	55	56	58	59	61	62
12	64	66	67	69	71	72	74	76	77	79
13	81	83	85	86	88	90	92	94	96	98
14	100	102	104	106	108	110	112	114	117	119
15	121	123	125	128	130	132	135	137	139	142
16	144	146	149	151	154	156	159	161	164	166
17	169	172	174	177	180	182	185	188	190	193
18	196	199	202	204	207	210	213	216	219	222
19	225	228	231	234	237	240	243	246	250	253
20	256	259	262	266	269	272	276	279	282	286
21	289	292	296	299	303	306	310	313	317	320
22	324	328	331	335	339	342	346	350	353	357
23	361	365	369	372	376	380	384	388	392	396
24	400	404	408	412	416	420	424	428	433	437
25	441	445	449	454	458	462	467	471	475	480
26	484	488	493	497	502	506	511	515	520	524
27	529	534	538	543	548	552	557	562	566	571
28	576	581	586	590	595	600	605	610	615	620
29	625	630	635	640	645	650	655	660	666	671
30	676	681	686	692	697	702	708	713	718	724
31	729	734	740	745	751	756	762	767	773	778
32	784	790	795	801	807	812	818	824	829	835
33	841	847	853	858	864	870	876	882	888	894
34	900	906	912	918	924	930	936	942	949	955

[1]Computed from formula $\frac{(D - 4) \times 1}{16}$

[2]Source: See footnote 2 in table 8.

Table 16. — Scale of 16-foot logs to nearest board foot[1] from Scribner rule[2]

D.i.b. (inches)	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
6	12	13	14	15	16	16	17	18	19	20
7	21	22	23	24	24	25	26	27	28	29
8	30	31	32	33	34	36	37	38	39	41
9	42	43	45	46	47	48	50	51	52	54
10	55	56	58	60	61	63	64	66	67	69
11	70	72	74	75	77	78	80	81	83	84
12	86	88	90	91	93	95	97	99	101	102
13	104	106	108	110	111	113	115	117	119	121
14	123	125	127	129	131	133	135	137	140	142
15	144	146	148	150	153	155	157	159	161	164
16	166	168	171	173	175	177	180	182	185	187
17	180	191	194	196	199	202	204	207	210	213
18	216	218	221	224	227	229	231	234	237	240
19	243	245	248	251	254	257	260	263	266	269
20	272	275	278	281	284	287	290	293	296	299
21	302	305	308	311	314	317	320	323	327	330
22	334	337	340	344	348	351	354	358	361	365
23	368	372	375	379	382	386	390	394	397	400
24	403	406	410	414	418	422	426	429	432	436
25	440	444	448	452	456	460	464	468	472	475
26	478	482	486	490	494	498	502	506	510	514
27	518	522	526	530	534	538	542	546	550	554
28	559	563	567	571	575	579	583	587	592	597
29	602	606	611	615	620	624	629	633	638	642
30	647	651	656	660	665	669	674	678	683	688
31	693	698	703	708	712	717	722	726	731	736
32	741	746	751	756	761	766	770	775	780	785
33	790	795	800	805	810	815	820	825	830	835
34	841	846	851	856	862	867	872	877	883	888
35	894	900	905	910	915	921	926	931	937	942

[1]Computed from formula $V = 0.79D^2 - 2D-4$.

[2]Source: See footnote 2 in table 8.

Cubic-volume tables, based upon the total tree height and the diameter at breast height, are given in tables 17 and 18 for estimating pulpwood volumes. These tables can be converted to cords by dividing by 75 for pine, and 66 for hardwood. Some buyers now purchase pulpwood using cunits (100 cubic feet) rather than cords as the unit of volume. Use table 18 for hardwoods and for pine 20 years and younger that has not been thinned. Use table 18 for older pine and for pine that has been thinned at least once. The average weight of a cord of green, pine pulpwood is 5,200 pounds.

Sell large, high-grade (defect- and knot-free) logs for veneer (hardwood) or plywood (pine) whenever possible because these products bring the highest prices. Pine plywood plants will take

Table 17. — Merchantable cubic foot volume using total tree height (Form Class 70 - 74)[1]

D.B.H.[2] (inches)	Total tree height (feet)							
	30	40	50	60	70	80	90	100
	Pulpwood volume (cubic feet, inside bark)							
5	1.47	1.86	2.14	2.42				
6	2.32	2.84	3.29	3.66	4.27			
7	3.31	3.98	4.66	5.23	5.90	6.48		
8	4.70	5.46	6.47	7.35	8.23	9.11		
9	5.87	6.90	8.08	9.25	10.28	11.31	12.34	
10		8.55	10.20	11.66	13.13	14.59	15.87	
11		10.23	12.12	13.80	15.48	17.16	18.64	20.31
12		12.25	14.52	16.53	18.80	20.56	22.83	24.85
13		14.75	17.44	19.84	22.23	24.62	27.31	29.70
14			20.33	23.12	25.92	28.71	31.85	34.64
15			22.98	26.14	29.29	32.83	36.38	39.53
16			26.01	29.54	33.08	37.06	41.04	44.57

[1]Source: Bulletin 445, *Form Class Volume Tables for Use in Southern Pine Pulpwood Timber Estimating*, by Charles O. Minor, 1950. Louisiana State University, Agricultural Experiment Station, Baton Rouge, LA 39 p.

[2]Diameter at breast height (4½ feet above ground).

Table 18. — Merchantable cubic foot volume using total tree height (Form Classes 75 - 79)[1]

D.B.H.[2] (inches)	Total tree height (feet)							
	30	40	50	60	70	80	90	100
	Pulpwood volume (cubic feet, inside bark)							
5	1.62	2.06	2.37	2.69				
6	2.62	3.23	3.75	4.19	4.88			
7	3.81	4.58	5.35	6.01	6.78	7.44		
8	5.20	6.05	7.19	8.18	9.17	10.17		
9	6.43	7.59	8.91	10.23	11.38	12.54	13.69	
10		9.59	11.48	13.16	14.84	16.52	17.99	
11		11.64	13.85	15.81	17.77	19.73	21.69	23.40
12		13.80	16.42	18.74	21.36	23.40	26.02	28.35
13		16.44	19.50	22.22	24.94	27.66	30.72	33.44
14			22.78	25.93	29.08	32.23	35.78	38.93
15			26.36	30.06	33.75	37.91	42.07	45.76
16			29.28	33.31	37.33	41.86	46.39	50.41

[1]See footnote 1 in table 17.
[2]Diameter at breast height (4½ feet above ground).

some surprisingly rough logs which they peel for core stock. In most areas, good markets exist for large, high-quality hardwood logs to be sawn into furniture stock. Low-quality hardwood logs are sawn into crossties, pallet stock, rough bridge timbers, and dunnage. Usually, no saw log is accepted under 8 feet in length. The minimum diameter for hardwood logs varies from 8 to 12 inches at the small end of the log. Chip-n-saw mills will take pine logs as small as 5 inches at the little end for manufacture into 2-inch dimension.

Straight, high-quality pines in the lower South are in good demand for poles and piling. Trees of suitable size and form usually bring more money per unit of board-foot volume as poles and piling than for sawlogs or other products. In some localities, pole-size hardwoods can be sold for river piling.

Stumpage prices for pulpwood, particularly hardwood pulpwood, are generally low except in a few areas of intense competition. Under most conditions, only the small material and early thinnings

should be marketed for pulpwood. In fact where good markets exist, 4-, 5- and sometimes 6-inch trees bring more as posts than for pulpwood. Pole-sized hardwoods within trucking distance of urban areas now bring more for fireplace wood than they do for pulpwood. All things considered, however, the marketing of small trees provides some early monetary return and helps to put the stand in good growing condition, but is not a very lucrative operation. Table 19 shows the comparative values for pulpwood and sawtimber.

In the past, emphasis was placed upon doing your own logging. Unless you are in a business in which trucks and tractors are used, it is not practical to invest in these vehicles. Equipment investment is too great to be practical if you do no more than cut a little firewood or a few fence posts.

A sample timber sale agreement is given in figure 21. Because legal requirements vary by State, check to see if this sample contract is sufficient to protect your interests, in your State. To make a good sale, it is absolutely essential to know how much timber you have to sell. Do not hesitate to ask and pay for professional advice. Remember that you are an amateur dealing with professionals.

You have a choice of selling for a lump sum all designated timber, or selling for a price per thousand board feet, per cord or per ton. In selling for a lump sum, the price is determined on the basis of tree measurements made at the time the trees are marked for cutting. The chief advantages of selling on a lump-sum basis are that there is no question about the scale, the purchaser is not held up awaiting a scale of timber by the owner, and the purchaser uses most of the wood by taking poorer parts of the designated trees. Purchasers will accept this wood because they pay nothing for it.

When selling at a unit price, the owner must scale all the timber as it is cut or take the buyer's word for the scale. Some buyers of sawtimber who also operate sawmills prefer to buy on mill scale (scale of lumber after sawing). You will benefit from this system only when you take all or part payment in the form of sawn lumber.

If you make frequent timber sales or plan to make a large sale, check with a tax expert for possible effects of the type of sale. Capital gains benefits could be lost if the wrong choice is made.

In some States, the extension service or the State forestry agency issue quarterly marketing reports that give the average and

the range in stumpage prices for forest products in various areas of the State.

Table 19. — Alternative pulpwood and sawlog stumpage prices for loblolly pine.[1]

D.B.H.[2]	Cords per Mbf	Dollars per Cord						
		4	6	8	10	12	14	16
		International ¼-inch Rule						
8	4.0	16.00	24.00	32.00	40.00	48.00	56.00	64.00
9	3.7	14.80	22.20	29.60	37.00	44.40	51.80	59.20
10	3.4	13.60	20.40	27.20	34.00	40.80	47.60	54.40
11	3.2	12.80	19.20	25.60	32.00	38.40	44.80	51.20
12	2.9	11.60	17.40	23.20	29.00	34.80	40.60	46.40
13	2.7	10.80	16.20	21.60	27.00	32.40	37.80	43.20
14	2.5	10.00	15.00	20.00	25.00	30.00	35.00	40.00
		Scribner Rule						
8	4.4	17.60	26.40	35.20	44.00	52.80	61.60	70.40
9	4.1	16.40	24.60	32.80	41.00	49.20	57.40	65.60
10	3.8	15.20	22.80	30.40	38.00	45.60	53.20	60.80
11	3.6	14.40	21.60	28.80	36.00	43.20	50.40	57.60
12	3.4	13.60	20.40	27.20	34.00	40.80	47.60	54.40
13	3.2	12.80	19.20	25.60	32.00	38.40	44.80	51.20
14	3.0	12.00	18.00	24.00	30.00	36.00	42.00	48.00
		Doyle Rule						
8	6.8	27.20	40.80	54.40	68.00	81.20	95.20	108.80
9	6.8	27.20	40.80	54.40	68.00	81.20	95.20	108.80
10	6.8	27.20	40.80	54.40	68.00	81.20	95.20	108.80
11	6.3	25.20	37.80	50.40	63.00	75.60	88.20	100.80
12	6.2	24.80	37.20	49.60	62.00	74.40	86.80	99.20
13	5.2	20.80	31.20	41.60	52.00	62.40	72.80	83.20
14	4.5	18.00	27.00	36.00	45.00	54.00	63.00	72.00

[1]Adapted from *Loblolly Pine*, by W. G. Wahlenberg

[2]Diameter of trunk in inches, at breast height (4½ feet above ground).

Figure 21. — Sample timber sale agreement.

_____ of _____
(I or We) (Name of purchaser) *(Post Office Box, etc.)*

_____ hereinafter called the purchaser, agree to purchase
(City, State)

from _____ of _____
(Seller's name or names) *(Post Office Box or address)*

_____ hereinafter called the seller, the
(City, State)

designated timber from the area described below.

I. Description of the sale area: Section _____

Township _____ Range _____

II. Trees designated for cutting: _____

III. The purchaser agrees to the following:

1. To pay the seller for the designated timber the sum of $ _____ payable in advance of cutting as required by the seller. The seller makes no guarantee of volumes in this agreement.
2. To waive all claim to the above-described trees unless they are cut and removed on or before _____
(date)
3. To pay the seller for any undesignated trees cut or injured through carelessness at the rate of three times the stumpage value. Damage to monuments or witness trees and reproduction will be held to a minimum.
4. To protect all operations from fire and to be held responsible for damages from fire resulting from negligence in the operations of the purchaser or of any agents.
5. To repair damage caused by logging to ditches, fences, bridges, roads, trails or other improvements damaged beyond ordinary wear and tear.

(continued)

Figure 21. — Sample of timber sale agreement, continued.

6. To be responsible for the entire work under this contract and for all tools, appliances and property of every description used in the removal of the designated timber. The purchaser shall specifically and distinctly assume all risks of damage or injury to persons or property resulting from any actions or operations under this contract or in connection with the work.
7. To assume all responsibility for the timber after award of the sale. The seller will continue to exercise all usual care for protection of the property during the sale period, but will not be responsible for any loss or damage from any cause whatsoever during that period.
8. To assign this agreement in whole or in part only with the written consent of the seller.
9. To permit the authorized representative of the owner to inspect harvesting as it is done. The presence of this representative will, in no case, relieve the purchaser of responsibility for performance of the terms of this contract.
10. To regenerate the area harvested by

_____, by_____
(date) *(method)*

either at cost or as part of the purchase price.

IV. The seller agrees to the following:

1. To guarantee title to the forest products covered by this agreement and to defend it against all claims at the seller's expense.
2. To grant freedom of entry and right-of-way to the purchaser and employees on and across the area covered by this agreement, and also other privileges usually extended to purchasers of stumpage which are not specifically covered, provided they do not conflict with specific provisions of this agreement.

Signed in duplicate this_____ day _____, 19_____

(Signatures of Purchaser, Seller, Witnesses)

WHERE TO GO FOR HELP

Most landowners need technical assistance. This help is available, but all too frequently only the best informed landowner uses it. Here are some of the people and agencies that stand ready to help.

Your State forestry agency employs professional foresters to serve as county or unit foresters. These men and women will provide forest management, insect and disease management, and marketing assistance to landowners. In some States, vendor services are provided to plant trees or to do timber stand improvement work at cost. Generally, a limit is put on the amount of time, timber marking help, or size of timber sale involved in any service given by the agency.

USDA's Soil Conservation Service will prepare a farm plan for cooperating landowners. This plan will identify those portions of the farm best suited for growing trees. The plan will include an aerial photograph and a soils map that will be of great value to the county forester in preparing a forest management plan for you.

Your State Extension Service at the land-grant colleges and universities employs foresters to provide information to you about forest management, use of wood products, stumpage prices, taxes, etc. These specialists closely follow the research underway at the forestry schools and help to get practical results into use in the field as soon as possible.

USDA's Agricultural Stabilization and Conservation Service, through the county offices offers landowners cost-sharing assistance under the Agricultural Conservation Program and the Forestry Incentives Program. Under these programs, you may receive as much as 75 percent of the cost (to a set maximum) of the installation of practices that will benefit the forest, wildlife, grazing, and water resources.

Industrial foresters are increasingly available to work with landowners who may be prospective suppliers of wood to the companies who employ these foresters. They often provide free timber marking and management plans. All that most of them ask in return is to have the "right of first refusal" when you have

some timber to sell. They particularly like to work with owners of tracts of 200 acres or larger.

Consulting foresters are independent professionals who provide technical services for a fee. Many of them offer vendor services for tree planting and timber stand improvement. They are particularly adept in handling timber sales. Absentee owners of large stands may find the consultant is very often the best source of help.

For further information on herbicide application, contact the Vegetation Management Project Leader, Southern Forest Experiment Station, USDA Forest Service, DeVall Drive, Auburn University, AL 36849-5426.

REFERENCES

PART I

The following publications have been used in preparing this booklet. Copies are available without charge from USDA Forest Service, 1720 Peachtree Road, N.W., Suite 850, Atlanta, GA 30367. If you request copies, please mention the numbers shown after the titles.

Choose Your Seedlings Carefully, Forestry Bulletin R8-FB/M 8.

Direct Seeding Oaks, Forestry Bulletin R8-FB/M 7.

Firewood Worth Calculator. Unnumbered item; circular slide rule.

Guide for Prescribed Fire in Southern Forests. Technical Publication R8-TP11.

How to Identify and Control White Pine Root Decline. Forestry Bulletin SA-FB/P6.

How to Identify Fusiform Ruse and What to Do About It. Forestry Bulletin SA-FB/P24.

How to Save Your Fusiform Rust Infected Pines by Removing Cankers. Forestry Bulletin SA-FB/P7.

Insects and Diseases of Trees in the South. Protection Report R8-PR 16.

Low Cost Site Preparation: Fell and Burn. Management Bulletin R8-MB 32.

Managing Site Damage from Logging. Forestry Bulletin R8-FB/M 6.

Optimum Timing for Ground-applied Forestry Herbicides in the South. Management Bulletin R8-MB 28.

Passive Loss Rules for Noncorporate Timber Owners. Management Bulletin R8-MB 29.

Plant Them Deep and Keep Those Roots Straight! Management Bulletin R8-MB 27.

Tax Tips for Forest Landowners. Management Bulletin R8-MB 58.

Forest Owner's Guide to Timber Investments, the Federal Income Tax, and Tax Recordkeeping. Ag. Handbook No. 681. Available from Government Printing Office Bookstore, P.O. Box 56445, Atlanta, GA 30343. Check or money order for $5.00 should be made payable to Superintendent of Documents.

Single free copies of the following publications are available from the address shown below. Copies are not available from the Forest Service.

How to Market Your Timber for More Money, by Alden C. Main and Robert H. Mills, Rev. July 1986. Cooperative Extension Pub. No. 1805. Louisiana State University, Publications Office, Room 128, Knapp Hall, Baton Rouge, LA 70803-1900.

Prescribed Burning in Louisiana Pinelands, by A. B. Crow and C. L. Shilling. Extension Publication 1618. Available from Baton Rouge address above.

PART II

We also used information from the following publications. Copies are no longer in print, but may be consulted at a library.

Forest Management Plan for Small Landowners, by H. L. Williston. 1974. Unnumbered forest management bulletin. USDA Forest Service, Southeastern Area, Atlanta, GA. 6 pages.

Form Class Volume Tables for Use in Southern Pine Pulpwood Timber Estimating, by Charles O. Minor. 1950. Bull. No. 445, Louisiana State Univ. Agric. Experiment Station, Baton Rouge, LA. 39 pages.

Guidelines for the Control of Insect and Mite Pests of Foods, Fibers, Feeds, Ornamentals, Livestock, Household, Forests and Forest Products. P. H. Schwartz and D. R. Hamel, Editors. 1980. Agriculture Handbook No. 571. USDA Agriculture Research Service and Forest Service, Washington, D.C. 796 pages.

Proceedings of the Workshop on Management of Southern Forests for Non-game Birds. 1978. General Technical Report SE-14. USDA Forest Service, Southeastern Forest Experiment Station, Asheville, N.C. 175 pages.

Response of Selected Woody Plants in the United States to Herbicides, by Rodney W. Bovey, 1978. Agriculture Handbook No. 493, USDA Agricultural Research Service, Washington, D.C. 101 pages.

Site Preparation: Why and How, by William E. Balmer, et al. 1976. Unnumbered forest management bulletin. USDA Forest Service, Southeastern Area, Atlanta, GA 8 pages.

Suggested Guidelines for Weed Control. 1980. Agriculture Handbook No. 565. USDA Agricultural Research Service, Washington, D.C. 330 pages.

Wildlife Versus Prescribed Fire in the Southern Environment, by Hugh E. Mobley and Ed. Kerr. 1973. Unnumbered bulletin. USDA Forest Service, Southeastern Area, Atlanta, GA 6 pages.

GLOSSARY

All-aged management — The management of a stand or tract to provide for trees of all or almost all age classes up to harvest age.

Artificial regeneration. — Reestablishing trees either by planting seedlings or sowing seed.

Basal area. — The area, usually in square feet, of the cross section of a tree at breast height (4½ feet above ground).

Clear-cutting, commercial. — The cutting of all merchantable trees from an area. Often leaves a large number of unsalable trees.

Clear-Cutting, silvicultural. — The cutting of all standing trees from an area before regeneration. This practice often combines a commercial clear-cut with a follow-up treatment to cut unmerchantable trees.

Crop tree. — Any tree selected to grow to final harvest or to a selected size.

D.B.H. (d.b.h.). — The diameter of a tree measured in inches at breast height (4½ feet above the ground).

Dominant. — An individual tree or species of tree with the crown (tops) in the upper layer of the tree canopy.

Dormant Seedlings. — Seedlings that have temporarily ceased visible growth (sometimes called a resting stage) because of high or low temperature, moisture or other external causes.

Even-aged management. — Managing a stand or tract for trees of the same or nearly the same age. A large forest may have stands of several ages.

Firebreak. — An area used to slow or stop fires either by clearing to mineral soil or use of green or slow-burning vegetation.

Group selection. — Removal of small groups of trees to regenerate the opening thus created.

Improvement cut. — Removal of less valuable, unhealthy, or less desirable trees.

Intolerant species. — Trees that will not thrive in the shade of larger trees.

J-Root. — Seedling roots planted in a manner that forms a J-shaped configuration in the planting slit. Such seedlings may grow poorly or die.

L-Root — Seedling roots planted with roots forming an L-shaped configuration. Such seedlings may grow poorly or die.

Natural regeneration. — Regenerating a stand of trees using seed from trees either on-site or nearby, or sprout growth for some species of hardwoods.

Prescribed burning. — Using fire as a tool under carefully controlled conditions in forest management and protection.

Root collar. — The stem of a seedling at the ground line at the time of removal from the nursery.

Rotation. — The planned number of years between the regeneration of a stand and the final cut.

Selective cutting. — The periodic removal of individual or groups of trees to improve or regenerate a stand.

Shelterwood. — A system of cutting to develop a new crop of trees under a portion of the old stand which provides adequate seed and, in some cases, protection.

Site Index. — A measure of the productivity of a site as indicated by the height of the dominant trees in the stand at an arbitrarily chosen age (both 25 and 50 years are used in the South).

Stratified seed. — Seed that has been stored in a cool, moist condition before use. This storage practice hastens the germination of some species.

Suppressed tree. — A tree that is not free to grow because of crown competition from above; as a result, the tree grows slowly.

Tolerant species. — A species of tree that has the ability to grow in the shade of, and in competition with, other trees. An intolerant species is unable to withstand this competition or grows poorly under the same conditions.

CAUTION

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key — out of the reach of children and animals — and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed them. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Environmental Protection Agency, consult your State forestry agency, county agricultural agent or State extension specialist to be sure the intended use is still registered.